State of Indiana

County of Bartholomew

Before the Bartholomew County

Board of Zoning Appeals

Case #: B/CU – 14 - 04

In the Matter of an Application
For a Conditional Use Application
Filed by William R. Gelfius
For Innovative Ag Solutions, LLC

SUBMISSION OF REMONSTRATORS

Respectfully submitted,

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TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

THE CAFO: IMPLICATIONS FOR RURAL ECONOMICS IN THE US

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The CAFO: Implications for Rural Economies in the US

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Introduction

In 1946, anthropologist Walter Goldschmidt used a number of social indicators to demonstrate that rural communities in California surrounded by large farms did not do as well as similar communities in areas where smaller farms were the rule (Goldschmidt, 1946). As the number of large, Confined Animal Feeding Operations (CAFOs) increased, particularly during the late 1980s and the 1990s, a substantial body of literature expanded, tested and generally confirmed Goldschmidt's work (Buttell, Larson and Gillespie, 1990; Lobao, 1990; Durrenberger and Thu, 1996; Lyson, Torres and Welsh, 2001; Welsh and Lyson, 2001).

Direct Economic Losses by Neighbors of CAFOs

CAFOs are a point source of both water and air pollution that falls unevenly across the area surrounding the CAFO and air pollution generally imposes the most significant costs on surrounding residents. Those rural farmers and ranchers closest to the CAFO bear most of these costs.

The economic loss suffered by the neighbors of a CAFO can be significant. Costs shifted to the residents of the region by a CAFO lower the sales and taxable value of neighboring properties. Palmquist et al., in a 1995 study in North Carolina, found that neighboring property values were affected by large hog operations based on two factors: the existing hog density in the area and the distance from the facility. The maximum predicted decrease in real estate value of 7.1 percent occurred for houses within one-half mile of a new facility in a low hog farm density area. 1997 and 1998 updates of this study found that home values decreased by $.43 for every additional hog in a five mile radius of the house. For example, there was a decrease of 4.75% (about $3000) of the value of residential property within 1/2 mile of a 2,400 head finishing operation where the mean housing price was $60,800 (Palmquist, 1995; Palmquist, Roka, and Vukina, 1997, pp. 114-124).

A 1996 study by Padgett and Johnson found much larger decreases in home value than those forecast by Palmquist. In Iowa, hog CAFOs decreased the value of homes in a half-mile radius of the facilities by 40%, within 1 mile by 30%, 1.5 miles by 20% and 2 miles by 10%. In addition, an Iowa study found that while some agricultural land values increased due to an increased demand for "spreadable acreage," total assessed property value, including residential, fell in proximity to hog operations (Park, Lee and Seidl, 1998).

An eighteen month study of 75 rural land transactions near Premium Standard's hog operations in Putnam County, Missouri conducted by the departments of Agricultural Economics and Rural Sociology at the University of Missouri found an average $58 per acre loss of value within 3.2 kilometers (1.5 miles) of the facilities. These findings were confirmed by a second study at the University of Missouri-Columbia by Mubarak, Johnson, and Miller that found that proximity to a hog CAFO does have an impact on property values. Based on the averages of collected data, loss of land values within 3 miles of a hog CAFO would be approximately $2.68 million (US) and the average loss of land value within the 3-mile area was approximately $112 (US) per acre (Mubarak, Johnson and Miller, 1999).

A compilation by the Sierra Club of tax adjustments by county assessors in eight states documented that lower property taxes follow these decreases in property value. Local property tax assessments were lowered in Alabama, Illinois, Iowa, Kentucky, Maryland, Michigan, Minnesota and Missouri by ten to thirty percent due to their close proximity to the corporate hog CAFOs. Real estate appraisers have also noted the problems associated with property values and large hog operations. In an article in the July, 2001 Appraisal Journal, John Kilpatrick found that

> [w]hile the appraisal profession has only begun to quantify the loss attributable to CAFOs,.....diminished marketability, loss of use and enjoyment, and loss of exclusivity can result in a diminishment ranging from 50% to nearly 90% of otherwise unimpaired value (Kilpatrick, 2001, p. 306).

As a result, diminishment effects continue to be considered when tax valuations are determined around large CAFOs. On September 14, 2001, Clark County, Illinois established an assessment abatement for fifty residential homes around the Welsh Farm (a hog CAFO) in northeast Clark County. For those homes within a half-mile of the hog production facility, there is a 30 percent reduction in the property assessment; 25 percent reduction within three-quarters of a mile; 20 percent within one mile; 15 percent within one and one-quarter miles; and 10 percent for one and one-half miles (Beasley, 2001).

Local Economic Effects of CAFOs

A CAFO is structured to view local residents as nuisances instead of assets. CAFOs crave isolation, and they are carefully designed to facilitate an isolated existence. They select areas close to good roads and railroads so they can import those things they need to build their facilities and local, county, state, and national laws and policies on the environment and on zoning are important determinants of the location of CAFO facilities (Hennessy and Lawrence, 1999, p. 53). In a USDA report published in 2000, Sullivan *et al.* found that

> "animal industries tend to move to areas with a lax environmental regulatory structure....[T]he more a state spends on environmental enforcement, the less likely a given firm will locate in that state. Differences in level of enforcement among nearby states, especially if competitors already operate in the area, may also affect location decisions...Location decisions, while important at the state level, also have an international context, with concerns about large production companies shifting investment outside the U.S. (Sullivan, Vasavada, and Smith, 2000, pp.22, 23).

In the last five years, CAFO owners have responded to the growth of county-level regulation by attempting to remove the ability to regulate air and water pollution from the counties and to locate it in state or provincial governments where political influence could be more easily exerted.

To reduce costs, the CAFO makes every effort to pay as few taxes as possible. This mandates locating in areas with existing infrastructure or infrastructure the public will finance. This also gives the CAFO an incentive to leave an area before the tax base deteriorates and before tax rates increase.

Because they are intent on finding isolated locations, CAFOs are also designed to use out-of-area suppliers. These may be other members of their vertically integrated organization, or they may simply be the lowest cost supplier who ships into the region using the rail or road infrastructure the CAFO specified as part of its site requirements. The transportation links the CAFO uses to bring its supplies into the region are also used to ship what it produces out of the region. The overall effect is that of the camper who brings what he needs, stays for a while, and departs--leaving behind whatever pollution and environmental damage were caused by the stay. Those rural residents who are affected by the pollution created by the CAFO, and who are likely to complain loudly as a result, are nuisances to be avoided or removed as expeditiously as possible.

Proponents of CAFOs often justify the construction of CAFOs on economic grounds and specifically, rural economic development. However, the economic characteristics that generally define a CAFO are fundamentally incompatible with rural regional economic development. Regional economic development proceeds on the premise that the wages paid and purchases made by a company are transferred to other individuals or companies in the region. The multiplier effect of these payments further assumes that they are again spent within the confines of the region and that they do not "leak" into other areas of the state or nation. However CAFOs are structured so they cannot aid regional economic development for the following reasons:

(1) Constraints on Regional Economic Development Due To Employment

As a capital intensive company, a CAFO is designed to minimize the number of workers and hence, minimize the economic impact on the region. A 1998 Colorado State University study found that only 3-4 direct jobs (jobs with the hog producer) are created for every 1000 sows in a CAFO sow farrowing operation (Park, Lee and Seidl, 1988). Ikerd calculated that a farrow-to-finish contact hog operation would employ about 4.25 people to generate over $1.3 million in revenue. His figures showed that an independently operated hog farm would employ about 12.6 people to generate the same amount of hog sales (Ikerd, 1998, pp. 281-283). Further, a number of studies have found that compared with small farms with an equivalent composite production value, a large farm tends to buy a smaller share of consumption and production inputs in nearby small towns (Chism and Levins. 1994; Henderson, Tweeten, and Schreiner. 1989, p. 31–35).

This is important because each farm job adds another job in local communities and another in the state outside the local communities. Similarly, each $1,000 of farm income adds another $1,000 to local communities and another $1,000 to the state outside the local communities (Sporleder, 1997, p. 9). Either of these figures probably overstate the economic impact on rural counties. For the employment multiplier to operate at these levels all employees must both live and work inside the region. Given the ability to commute, it is likely that many workers will live well outside the region and that the resulting employment multiplier will be further depressed.

The size of the employment multiplier further depends on amount of purchases a CAFO makes in the region. Large scale animal production facilities are more likely to purchase their inputs from a great distance away, bypassing local providers in the process (Lawrence et al. 1994). A 1994 study by the University of Minnesota Extension Service found that the percentage of local farm expenditures made by livestock farms fell sharply as size increased. Farms with a gross income of $100,000 made nearly 95% of their expenditures locally while farms with gross incomes in excess of $900,000 spent less than 20% locally (Chism and Levins, 1994).

Confined animal production can occasionally benefit local grain sellers, but only when it consumes all the grain produced in the county. If the county has to export even one bushel of grain, all the grain in the county will have to be priced at a lower level that will enable the grain to compete in the export market (Hayes, 1998).

(2) Constraints on Regional Economic Development Due To Taxes

Federal, state, provincial and local taxes are levied on taxable amounts calculated on federal returns. Numerous tax write-offs that are possible because CAFOs are sometimes treated as industries and, at other times, treated as farms. These write-offs significantly decrease the amounts of taxes paid locally. At the same time, the operations of the CAFO create social, health and traffic costs that the local government must finance. The local government, in turn, must rely on increased taxes to pay these CAFO-induced costs--and this can decrease other economic activity in the region.

For example, additional costs associated with hosting a CAFO include increased health costs, traffic, accidents, road repairs, and environmental monitoring. One Iowa community estimated that its gravel costs alone increased by about 40% (about $20,000 per year) due to truck traffic to hog CAFOs with 45,000 finishing hogs. Annual estimated costs of a 20,000 head feedlot on local roadways were $6447 per mile due to truck traffic (Duncan, Taylor, Saxowsky and Koo, 1997). Colorado counties that have experienced increases in livestock operations have also reported increases in the costs of roads, but specific dollar values are not available. In addition, an Iowa study found that while some agricultural land values increased due to an increased demand for "spreadable acreage," total assessed property value, including residential, fell in proximity to hog operations (Park et al., 1998).

(3) Constraints on Regional Economic Development Due To Adverse Local Business Impacts

In a 2001 study of farming dependent areas, Tweeten and Flora found that if they create environmental problems, newly developed or arrived CAFOs may undermine a community's opportunities to expand its economic base. They also found that the vertical coordination structure used by large CAFOs can cause a loss of resources from farms and rural communities because CAFO facilities tend to be so large and because ownership and control may reside in distant metropolitan centers. All else being equal, they found the productivity gains attributed to large CAFOs decrease aggregate employment and other economic activities in rural communities (Tweeten and Flora, 2001, p. 32).

Rural sociologists Thomas Lyson of Cornell University of Ithaca, N.Y. and Rick Welsh of Clarkson University of Potsdam, N.Y. found that agricultural counties without corporate farming laws generally had higher poverty and unemployment rates and lower cash returns to farming. 433 agricultural counties--defined as at least 75% of land in farms and 50% of gross receipts for goods and services from farm sales—were studied. Rural community welfare, measured by percentage of families in poverty, percentage unemployed and percentage of farms in a county realizing cash gains was higher in states with anti-corporate farming laws. States with more restrictive anti-corporate laws also fared better than states with less restrictive laws (Lyson and Welch, 2001).

A study of 1,106 rural communities by Gómez and Zhang of Illinois State University found that large hog farms tend to hinder rural economic growth at the local level.. All models in this study indicated an inverse relationship between hog production concentration and retail spending in local communities. Economic growth rates were 55% higher in areas with conventional hog farms as opposed to those with larger hog operations in spite of the fact that economic growth rates had been almost identical in all the studied communities before the advent of larger hog operations in the1990s. Data in the study also showed that communities with heavy hog concentration suffered larger population losses than those with conventional hog operations. According to the authors, the results of this study suggest that without public policy to protect rural communities, the most probable outcome is the continuing decline of rural communities in the future as the size of agriculture and livestock production units continue to increase (Gómez and Zhang, 2000).

A second study by Gómez of 248 towns in hog-producer counties covering the period 1981-1999 demonstrate that smaller hog farms contribute to stronger rural economies and large hog farms are associated with lower economic growth. While there were not significant differences in real retail spending across towns before 1990, if concentration in hog production was 1 percent lower in town A than in town B after 1990, then annual real retail sales were higher in town A by 0.27 percent. Such differences, compounded over a fifteen-year period, result in real spending in town A being higher by 4.13 percent than in town B (Gómez, 2002).

In February, 2002, the Iowa Concentrated Animal Feeding Operations Air Quality Study found important emerging issues surrounding "the intensification of livestock production that include the socioeconomic impacts in rural communities. These issues include...decline in local economic activity and increases in purchases of some animal production inputs from outside the local area, as CAFOs increase in size and number... Studies in Michigan, North Carolina, and Missouri found that the value of real estate close to CAFOs tended to fall. These and other data show that CAFOs are defined by present and potential neighbors as at least a nuisance" (Iowa Concentrated Animal Feeding Operations Air Quality Study, 2002, pp 5-15).

CAFOs and the Right of Exclusive Use

Laws that remove the ability of residents to control air pollution on their property attack the right of exclusive use, a fundamental legal principle which states that:

> those who have no claim on property should not gain economic benefit from enjoyment of the property. In other words, the right of use is exclusive to the property owner, and any violation of the right of exclusive use typically carries either payment of compensation to

the rightful owner or assessment of a penalty. For example, if "A" trespasses on land owned by "B," then "A" will be guilty of a crime and a possible criminal penalty may be in order, as well as civil damages. Physical impairment, such as the odor or flies, in effect is a trespass on property rights and violates the right of exclusion (Kilpatrick, 2001, p. 303).

Both the legal and economics professions view the right of exclusive use as fundamental to the long term beneficial use of property. If exclusive use is violated, those who own the land cannot be assured of compensation for the use of their property and they will tend to adopt short sighted land use policies—for example, accepting the pollution of a contract hog operation in return for short-term economic gain. This lowers both the efficiency with which the property is used and the long-term societal benefits gained from use of the property (Snare, 1992; Stigler, 1992).

In the context of this discussion, just as the cost of airborne pollution falls unevenly on the neighbors of the CAFO, so does the loss of the right to exclusive use. This, in turn, means that the residents around the CAFO are more likely to act in a manner that increases their short-term gain at the expense of long term societal benefits. This is precisely the kind of activity CAFO owners desire because it leads to the creation of more CAFO sites. Unfortunately, the side effect of these actions is to hasten the depopulation of rural agricultural areas where CAFOs are located as more and more land is rendered uninhabitable due to air pollution.

One could claim that the setback provisions of any CAFO permitting regulation, whether they be county or state/province based, will prevent the loss of exclusive use that has been described in the previous paragraphs. This is unlikely for a number of reasons. First, setback requirements usually stipulate distances that are considerably less than those that have already been shown to be associated with losses in property and tax values. But even if one could assume that a setback requirement had been properly sized to reduce to zero all problems with airborne pollution, the setback itself establishes an area around a CAFO where normal development and normal residences are not permitted unless the owners are willing to waive all rights to exclusive use. In other words, potential residents within a setback radius could only build if they acknowledged that they were subject to air pollution and thus waived their rights to exclusive use. This means that every setback radius becomes a center of zero population growth.

Creation of a moral hazard

When a CAFO enters a rural region, it strikes a bargain with the rural residents. This implicit contract is usually formed around stated, but not legally enforceable, promises of jobs and economic impact on the region. The CAFO promises these things in return for land, water, access, power and the other factors equired for the CAFO to operate. This contract also implies a certain physical relationship with the region that manifests itself in the presence (or lack) of pollution, traffic, resource consumption, etc., that arise from the operation of the CAFO.

The CAFO is typically well informed about the legal contract with its vertical organization and the implied contract with the region because it signed the legal contract and it extended the offers on which the regional contract is based. But the residents of the region are privy to very little information about the CAFO's contract with its organization. As a result, there is an incentive on the part of the CAFO to shift costs between the contracts based on each party's access to information about those costs. The party with the least information about costs is most likely to

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AN ANALYSIS OF THE IMPACT OF SWINE CAFOs ON THE VALUE OF NEARBY HOUSES

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2

An Analysis of the Impact of Swine CAFOs on the Value of Nearby Houses

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ABSTRACT

The impact of 39 swine confined or concentrated animal feeding operations (CAFOs) in Black Hawk County, Iowa on 5,822 house sales is explored by introducing a new variable that more accurately captures the effects of prevailing winds, exploring potential adverse effects within concentric circles around each CAFO, managing selection bias, and incorporating spatial correlation into the error term of the empirical model. Large adverse impacts suffered by houses that are within 3 miles and directly downwind from a CAFO are found. Beyond three miles, CAFOs have a generally decreasing adverse impact on house prices as distance to the CAFO increases.

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JEL Codes: Q51, Q53, R21

An Analysis of the Impact of Swine CAFOs on the Value of Nearby Houses

Introduction

Swine confined or concentrated animal feeding operations (CAFOs) can be and often are considered to be locally undesirable land uses (LULUs). Unpleasant odors and ground water contamination tend to be the greatest concerns of those who live near swine CAFOs. This situation has intensified since passage of the federal Pork Production, Research and Consumer Education Act (PPRCEA) in 1985, which lead to a significant increase in pork production. PPRCEA funded research into more efficient production techniques, especially CAFOs. During the late 1980s and early 1990s, two powerful influences, (1) PPRCEA funded advertising (pork, the other white meat) and (2) health concerns regarding the consumption of red meat, fueled a tremendous increase in the consumption and production of pork. Much of this increased production has been concentrated in a few, historically traditional, pork-producing states, particularly Iowa, North Carolina, Minnesota, and Illinois. As a result, nuisance complaints from those living near pork production sites, especially CAFOs, have increased. Lasley (1998) reports considerable concern with hog odors among rural Iowa residents. Van Keek and Bulley (1995) report that 95% of the nuisance attributed to farm odors can be traced back to swine CAFOs. In Iowa, some rural residences have sued nearby swine CAFOs as nuisances, and public hearings to consider new swine CAFO permits are overflowing with protesters.

The impact of proximity to swine CAFOs on housing values is a topic worthy of attention. To whatever extent swine CAFOs are the source of a negative externality deserves to be rigorously addressed, because the fears that the value of nearby homes might diminish could easily be exaggerated or overstated. Others have investigated this issue using proximity to a LULU to measure impact, implicitly assuming that any adverse effect will diminish with increasing distance from the source. However, relying solely on proximity as a measure of intensity can be problematic, because selection bias might distort the results. That is, the impact observed might be due to LULUs locating near low-valued houses. Therefore, additional measures of intensity and techniques to manage selection bias are desirable.

Spatial correlation abounds in housing sales data (Basu and Thibodeau, 1998; Isakson and Ecker, 2001; Case, Clapp, Dubin and Rodriquez, 2004) whereby two similar homes sell for a more similar price if they are closer geographically, than two homes farther apart. Omitted spatial variables and clustering of similarly priced homes are two sources of spatial correlation that, if omitted, will bias ordinary least squares (OLS) parameter estimates.

This study reviews previous studies of CAFOs, develops a spatial model for estimating the adverse affect associated with proximity to CAFOs, and applies this model to housing sales in a representative Iowa county. In particular, this study expands the approach taken in previous studies by (1) introducing a new variable that more accurately captures the effects of prevailing winds, (2) exploring potential adverse effects within concentric circles around each CAFO, (3) managing selection bias, and (4) incorporating spatial correlation into the error term of the empirical model

The organization of the paper is as follows: section 2 contains a review of the literature while the housing sales data and CAFO variables are examined in section 3. The statistical model is developed in section 4 while the results and findings are reported in section 5. The final section includes a discussion of the findings and suggests directions for further research.

Review of the Literature

Studies of the effects of a locally undesirable land use (LULU) on nearby housing values are abundant in the literature. In a meta-analysis, Simons and Saginor (2006) review 58 articles that study the impact on nearby property values of numerous LULUs, such as power lines, landfills, nuclear power plants, sex offenders, air pollution sources, and leaking underground storage tanks. They report that the adverse effect of a LULU diminishes with distance from the source.

In the earliest of the published studies of swine CAFOs, Palmquist, Roka, and Vukina (1997) examine 237 rural house sales in nine southeastern North Carolina counties, which occurred between January 1992 and July 1993. Unfortunately, due to privacy and confidentiality rules in North Carolina, the authors have no specific data for the locations of the CAFOs. Instead, they made use of data provided to them by the State Veterinarian's Office consisting of the total number of herds and capacity of swine

CAFOs within three bands (0-1/2 mile, ½-1 mile, and 1-2 miles) around each of the 237 sales. From the CAFO data, the authors construct a manure index, based on the type and number of animals at the CAFO to estimate the weight of manure produced within each of the three bands. Using nonlinear least squares, they estimate that the effect of proximity is up to negative 9% of the value of a house, depending on the amount of manure produced by the CAFO.

In the second published study, Herriges, Secchi, and Babcock (2003) examine 1,145 house sales that occurred between 1992 and 2000 in five Iowa counties for the effects of proximity to 550 livestock facilities. By including more years (8) and a larger geographical area (five counties) in their analysis, these authors have many more sales and CAFOs than previous studies. The five Iowa counties selected for study include some of the highest concentration of CAFOs in the state. The authors make use of several measures of the effects of a CAFO, including distance to the nearest CAFO, the number of CAFOs within three miles of a house, the size (live animal weight) of the CAFO, a manure index, and whether the house is downwind from the nearest CAFO in warmer and colder months. Very few of these CAFO variables are statistically significant. Proximity to the nearest CAFO in the colder months for houses downwind from a CAFO shows a statistically significant loss in value depending on the size of the CAFO (their prevailing wind variable is a binary (0,1) measure). The strongest adverse effect reported is proximity to smaller CAFOs with a price-with-respect-to-distance elasticity of 0.097 during the winter and 0.112 during the summer months. Interestingly, the larger CAFOs show a smaller negative impact associated with proximity than smaller

CAFOs. The authors suggest that one reason for this effect is the ability of the larger CAFOs to afford the costs of odor abatement techniques. Unfortunately, the Herriges, Secchi, and Babcock study does not estimate the effect of proximity separately from the size of a CAFO. Instead, they include interaction terms (log size times the log proximity; and the log size times the number of nearby CAFOs) without including the main effects, i.e., they do not allow for the potential for main effects alone being statistically significant by only checking if the interaction is important.

Others have also studied swine CAFOs. For example, Taff, Tiffany, and Weisberg (1996) in an unpublished paper examine 292 sales of rural, residential properties in two Minnesota counties that occurred from 1993 to 1994. These authors measure proximity to CAFOs using a series of three, one-mile rings around each sale. They also attempt to control for the size of the CAFO, wind direction, and number of CAFOs within three miles of a sale. In contrast to Palmquist, Roka, and Vukina, the authors report a positive effect associated with proximity to CAFOs. That is, houses closer to the CAFOs are reported as selling for more than those located further away, after controlling for other factors that traditionally affect housing values.

In another unpublished study, Hamed, Johnson, and Miller (1999) examine the sales of 99 rural parcels (39 with houses) in Saline County, Missouri that occurred between January 1, 1996 and December 31, 1997 for effects of proximity to CAFOs. The authors use a linear measure of distance to the nearest CAFO and find a loss of $112 per acre of land with houses and no impact on vacant land within three miles of a CAFO. In yet another unpublished study, Abeles-Alison and Connor (1990) examine housing sales surrounding eight swine CAFOs in Michigan that received multiple odor complaints during the first nine months of 1989. The primary purpose of their study is to estimate the impact on property tax revenues due to the presence of a CAFO in a township. The authors' analysis of 288 housing sales reveals that houses within 1.6 miles of a CAFO suffer a decline in value of $1.74 per animal in the CAFO. This impact is found to decrease with increasing distance from the CAFO.

The literature suggests that swine CAFOs can be a significant negative externality. Unfortunately, all previous studies suffer from at least of one of the following: the lack of data on location/intensity at the CAFO level; small sample sizes; the lack of ability to detect any effect due to wind; a model that does not account for spatially correlated data; and the lack of management of selection bias. This study uses measures of location and intensity both at the CAFO level and at the individual house level, includes a new cardinal, wind angle variable, uses larger sample sizes, manages selection bias, and incorporates a spatial correlation component into the model.

Data

This study combines two primary sources of data: (1) housing sales data and (2) swine CAFO data. The housing sales data consists of 5822 single-family sales in Black Hawk County, Iowa.[1] The number of sales in this dataset far exceeds the number of sales used in all of the previous studies. The sales data initially contained every transaction in the county from January 2000 to November 2004. These sales were refined by selecting only those transactions identified as "arms length transactions" by the county tax assessor's office. The sales were further refined by selecting only those sales with a selling price greater than $32,000 or less than $400,000, houses with at least three but less than 12 rooms, at least 500 square feet of living area, and a lot size greater than 3,000 square feet. In addition, due to limitations of the spatial model in this study, only the most recent sale, for any repeat sales, was used.

The housing sales data includes information on the following variables for each sale: date of sale, state-plane coordinates of the centroid of the property, municipal jurisdiction, year built, lot size, living area, and number of rooms. In addition to these variables, each sale includes calculations of the distance to selected points of influence; the CBDs of the two largest cities (Cedar Falls and Waterloo), the largest employer in the county (John Deere), and a large university (The University of Northern Iowa).

Information regarding CAFOs is difficult to obtain. CAFO owners are very reluctant to volunteer any data to researchers, because they fear that the information they disclose may be used against them. Thus, researchers are forced to use public records as their source of information. For each of the 39 swine CAFO sites in the county, information is obtained from the Iowa Department of Natural Resources (IDNR) on the following: state-plane coordinates of the centroid of the site, number of animal units permitted, and planned manure management techniques (method of applying manure to fields). Animal units represent a weighted sum that reflects the number and size of the animals permitted, whereby one animal unit is defined as one head of feeder cattle. Swine that weigh more than 55 pounds count as 0.4 animal units, while swine that weigh between 15 and 55 pounds count as 0.1 animal units. Animals less than 15 pounds are not counted. The manure management techniques are planned rather than actual, because the state only requires CAFO owners to report their planned, rather than their actual manure management techniques, and unfortunately, the Iowa DNR does not monitor compliance with CAFO manure management plans. Data regarding manure storage facilities and operational types are not included in this study, because this type of data is difficult to obtain, unverified, and often unreliable.

One of the major contributions of this study is the introduction of a non-linear, cardinal variable called *wind angle* that measures the extent to which a house is downwind from a nearby CAFO; see Figure 2. Prevailing winds data during the study period obtained online from the National Climatic Data Center is used to determine the prevailing (most frequent) wind directions, which are from the northwest in the colder months (135 degrees from the X-axis) and from the south-southeast in the warmer months (300 degrees from the X-axis). The variable wind angle is defined as zero for all homes upwind of the CAFO, because one would anticipate no (additional) wind effect for homes in a 180 degree field upwind from the nearest CAFO. Wind angle is 90 for houses directly downwind from the nearest CAFO. One would anticipate that the more directly downwind from a CAFO a particular house is (at a fixed distance from the CAFO), the greater the intensity of any airborne pollutants, such as obnoxious odors[2]. This wind effect may play an even stronger role in affecting home prices than just proximity to the confinement building when the source of the odor is a large area of land, such as the fields in the immediate vicinity of the CAFO where manure has been applied. The model also includes a seasonal binary variable indicating warmer or colder months based on the date of sale, and a binary variable that identifies on which side (north or south) of the prevailing winds the house is located. Lastly, a wind angle – season interaction variable is included to account for potential seasonality of the prevailing winds, i.e., to distinguish being downwind in the warmer versus the colder months.

The problem of selection bias in the data deserves attention. Selection bias can result when CAFOs and lower priced homes are clustered or concentrated in the same geographic area of the county, i.e. the low land prices attract CAFO owners as well as home buyers looking for inexpensive homes. One way to explore for selection bias is to examine house sales just before and right after a CAFO is opened and operating. This sort of event study is rarely performed and, moreover, establishing causality is extremely difficult since the observed price change could be due to the new CAFO or due to some other event. None of the previous studies of swine CAFOs make a direct attempt to manage selection bias, although Herriges, Secchi, and Babcock do so unintentionally by including the number of CAFOs within close proximity (three miles) of each sale. Munneke and Slawson (1999) manage selection bias in their study of mobile home parks by using a two-stage, random-effect, correction variable derived from a PROBIT analysis. Unlike covariates in standard (hedonic) regression models, their correction variable is not a fixed-effect; it has variability (sampling distribution/error) that is not accounted for in their final model. In the present study, selection bias is managed primarily by including a fixed-effect variable directly into the mean structure of the model to capture the extent of CAFO clustering (rather than a two-stage approach). If CAFO owners locate their operations near low valued houses, then one should observe clusters of CAFOs in very close proximity to low valued houses. Therefore, this study includes, for each sale, the count or number of CAFOs within a very close (1.5 mile) distance of each sale. If selection bias were present, then one should find more CAFOs located near lower valued houses (than located near higher-valued houses), i.e., the count variable will be statistically significant and negative. In addition to this count variable, this study also manages selection bias within an error term that accounts for spatial correlation, as seen in the next section.

Table 1 contains summary statistics of the 5822 sales and 39 CAFOs. Figure 2 contains a map of the locations of the sales, CAFO sites as well as the municipal boundaries of the major cities in the county. Most of the sales occur within the jurisdictional boundaries of five incorporated cities, while 254 of these sales occur within the unincorporated (rural) areas of the county. On average, houses in the dataset are four miles from the nearest CAFO, and one out of forty (146/5822) houses has a CAFO located within 1.5 miles. The wind angle varies from zero to 90, with an average of 33.95, and about 20 percent of the sales occurred during one of the colder months.

The 39 CAFOs are permitted for an average of 977.5 animal units and range in size from 156 to 2005 animal units. About one-fourth of them (11/39) indicate that they plan to apply manure to fields in the vicinity of the confinement building using the older, traditional broadcast method. The rest intend to use newer methods, such as injection or knife methods.

Statistical Models and Methodology

This study starts with a hedonic regression model of house price that includes independent variables to control for factors that traditionally influence house prices, including size and age of the dwelling, as well as, a set of variables that can capture the potential adverse effects of proximity to a CAFO. Specifically, let,

P = the selling price of the house,
S = lot size in acres,
t = the time of the sale,
$\mathbf{C}$ = a vector of site level characteristics of the house that typically affects selling price,
$\mathbf{L}$ = a vector of site level spatial measures of proximity to other points of influence,
$\mathbf{J}$ = a vector of binary variables representing the jurisdiction in which the house is located
D = the distance to the nearest CAFO,
AU = the number of animal units permitted at the CAFO,
CT = the number of CAFOs within 1.5 miles of the home,
PW = the degree (0 to 90) that the house is downwind from the nearest CAFO,
WS = a binary variable representing the season (0 = summer; 1 = winter), and
$PWS = PW * WS$, a wind direction – season interaction variable.

then the selling price of a house can be expressed as,

$$P = \kappa S^{\rho} AU^{\pi} e^{\chi D + \phi t + \varphi \mathbf{C} + \gamma \mathbf{L} + \eta \mathbf{J} + \alpha CT + \beta PW + \delta WS + \lambda PWS} \varepsilon \qquad (1)$$

where the Greek letters represent parameters of the model to be estimated from the data. The site specific variables in **C** include living area, the number of rooms in the house and the year the house was built. The spatial variables in **L** include the distance to the CBD of two large cities (Waterloo and Cedar Falls) and distances to the two largest employers in the county (John Deere and the University of Northern Iowa) that dominate the labor markets in the county. This model includes independent variables to capture any adverse effect of CAFOs, including the size, wind-angle, and distance to the nearest CAFO.

We fit the hedonic model, equation (1), using a concentric circles statistical modeling approach, in which seven hedonic regression models are fitted for all sales that have a CAFO within 2, 2.5, 3, 3.5, 4, 4.5, and 5 miles of the house. An eighth hedonic regression model is fitted using all 5822 sales. Obviously, the results of the two mile hedonic regression analysis, with $n_1 = 309$ sales, will have an impact upon the results of the 2.5 miles analysis, with $n_1 + n_2 = 507$ sales, due to the common $n_1 = 309$ sales. However, we choose the concentric circles analysis over a ring analysis (of solely the $n_2 = 198$ sales between 2 and 2.5 miles from the nearest CAFO) because the concentric circles analysis provides a more continuous and smooth look at how proximity to a CAFO affects selling prices, i.e., we explore how the independent variables change in both interpretation and statistical significance with proximity to the nearest CAFO. Ring analysis often results in a smaller sample size, produces much more variable results and is beset with highly influential sales. These effects can be smoothed out using concentric circles.

In addition, we include a spatial correlation component in the hedonic regression model, equation (1), by modeling the error term, ε, in a geostatistical manner (see Cressie (1993); Isakson and Ecker (2001); and Ecker (2003)), in lieu of the traditional OLS error term. Spatial correlation implies that, all things otherwise equal, two homes will sell for a much more similar price if they are closer geographically, compared to two otherwise similar homes much farther apart. Specifically, we model

$$\ln(\varepsilon) \sim N(0, \tau^2 + \sigma^2), \qquad (2)$$

where τ^2 is referred to as the "nugget" effect (a measurement error or micro-scale variability) in the geostatistical literature. The sum of the parameters $\tau^2 + \sigma^2$ in (2) represents the spatial variability of the spatial process or "sill", i.e., the variability of the home prices after adjusting for individual home characteristics. Lastly, for two home sales with errors ε_i and ε_j, we model the spatial correlation as a function of their Euclidean distance apart, d_{ij}. Specifically,

$$\mathrm{Corr}(\ln(\varepsilon_i), \ln(\varepsilon_j)) = \exp(-\phi d_{ij}) \qquad (3)$$

where ϕ controls the strength of the spatial correlation and is called the "range" parameter. The range indicates the distance beyond which home prices are (essentially) uncorrelated. Spatial correlation models, (2) and (3), are random effects models designed to "mop up" extra variability not captured in the mean structure in equation (1). In particular, unobserved variables and any selection bias not fully captured by the count of CAFOs within 1.5 miles of the home sale are managed by adding spatial correlation components, (2) and (3), to the model.

The spatial correlation parameters, the range, sill and nugget in (2) and (3), along with the site level mean structure parameters in (1), are estimated simultaneously, within each concentric circle, using a maximum-likelihood, iterative fitting technique.[3] Reasonable starting or seed values of the spatial correlation parameters are needed to ensure timely and accurate convergence of the fitting algorithm. These starting values for the range, sill and nugget for each concentric circle are obtained by fitting an exponential theoretical variogram model to an empirical variogram constructed from the residuals of an ordinary least squares (a non-spatial correlation) hedonic regression model.[4]

Results and Findings

The results of the eight, maximum-likelihood regressions are reported in Table 2 where the Goodness of Fit statistics indicates that as one adds more data in the larger diameter concentric circles, the model fits better. All of the house specific or structure variables have coefficients that are highly statistically significant, of reasonable magnitude and sign, and are very stable from one concentric circle to the next. Of the time variables, the date of sale is statistically important in all concentric circles, while the season variable is only important in the 4 mile concentric circle (in which, homes sold in warmer months sell for more that those sold in colder months). The date of sale coefficient shows lower rates of annual appreciation (3.7%) for those sales that are close to a CAFO. In the larger concentric circles, the annual rates of appreciation are higher (about 5%).

None of the distance variables are statistically significant in any concentric circle. It is not surprising that the CBDs of both cities are not strong points of influence, since they are not a major destination point for county residents. The employment and retail sites within the county are well disbursed, rather than concentrated at any particular point.

Very few of the city binary variables are statistically significant. Within the smaller concentric circles, no sales are present in some of the cities. Where the city variables have statistically significant coefficients, these coefficients suggest that houses sell for more within the two major cities. Higher house values within a city, as opposed to a rural area, are not a surprise.

The coefficients of the spatial correlation variables are fairly stable for all concentric circles except for the range parameter in the smallest concentric circle. This range coefficient suggests that the spatial correlations diminish rapidly beyond about two thirds of a mile (0.35 = 3500 feet). The nugget value is consistently about 0.02 and represents about 40% of the total variability. Thus for parcels located within about two thirds of a mile from each other, OLS techniques would unnecessarily use the entire sill for explanation and prediction, i.e. the covariance for closer parcels is as much as 60% less than the total variability.

The pattern of statistical significance and insignificance for the CAFO variables reveals considerable insight into which characteristics of a CAFO most adversely affect nearby house values. The count variable, minimum distance and the manure application variables are all statistically not significant. Thus, there appears to be no evidence for selection bias, nor are houses affected by the planned method of manure management. (The actual method, if it were known, could be more important than the planned method of manure management.) The lack of significance for the distance variable indicates that just being close to a CAFO, all by itself, does not greatly affect house prices (more than wind-angle or size of the CAFO, as seen below).

The CAFO variables animal units and wind angle exhibit statistical significance within several of the concentric circles. For a house located at 3 miles or closer to a CAFO, how much the house is directly downwind from a CAFO is the most important (most statistically significant) CAFO variable. Beyond 3 miles, the size of the nearest CAFO in animal units is the only statistically significant CAFO coefficient. For houses that are five miles or more from the nearest CAFO, those that are north of being directly downwind from a CAFO sell for more than those that are south.

The CAFO coefficients from the concentric circle analysis paint a picture showing that the prevailing winds play a much more important role for houses within three miles of a CAFO, while the size of the nearest CAFO plays a more important role in influencing home prices for houses that are further away. Note that the sign and magnitude of the animal unit coefficient for very close sales (within 2 and 2.5 miles) is consistent with the signs and magnitudes in the larger concentric circles. Thus, lack of significance for animal units at close distances might be attributed to the relatively few sales in the smaller circles. Lastly, the wind angle – season interaction is not significant for any concentric circle, suggesting that the effect of being downwind from a CAFO in the warmer months is no different than in the colder months. In the smaller three concentric circles (2, 2.5 and 3 miles), wind angle is a more powerful (more statistically significant) explanatory variable than any of the other CAFO variables. Houses directly downwind and within two miles of a CAFO can suffer as much as a 44.1 percent loss in value (but, only one house is essentially (89.1 degrees) directly downwind and within 2 miles of a CAFO; the rest are no more than 60 degrees downwind). At the average wind-angle

(33.95 degrees), the loss in value for houses within two miles of a CAFO is slightly over 16.6 percent. If a house is within 2.5 miles of a CAFO, the maximum loss in value is 15.3 percent, while at the average wind-angle, the loss is 5.8 percent. Houses directly downwind within three miles of a CAFO (holding CAFO size constant) suffer a maximum loss in value of 9.9 percent, while at the average wind angle they suffer a 3.7 percent loss in value. Beyond three miles, wind-angle is not as important (statistically significant) as the size of the CAFO. Within three miles of a CAFO, the elasticity of house price with respect to CAFO size (measured in animal units) is -0.1370, which on average, suggests about a 6.85 percent loss in value for a 50 percent increase in CAFO size. For all sales, the elasticity of house price with respect to CAFO size is -0.0668, which on average, suggests about a 3.34 percent loss in value for a 50 percent increase in CAFO size.

Analysis of the sales data indicates that houses within very close proximity (3 miles or closer) to a CAFO can suffer a substantial loss in value, especially if the house is directly downwind from a CAFO. Further away from a CAFO (beyond three miles), houses suffer diminishing adverse effects as one moves further away from the CAFO. Generally, the rate of appreciation in house values is higher for houses further away from a CAFO.

Summary and Conclusions

This study improves our understanding of how and to what extent swine confined animal feeding operations (CAFOs) impact the value of nearby houses by (1) using concentric circles to increase sample sizes, (2) introducing a new variable that captures the effects of prevailing winds, (3) using a model that accounts for spatially correlated data, and (4) managing the problem of selection bias. The study finds large adverse impacts suffered by houses that are very close (within 3 miles) to and directly downwind from a CAFO. Beyond three miles, CAFOs have an adverse impact on house prices, but this impact, in generally, diminishes with increasing distance from a CAFO.

This study also separates the effects of proximity, size, and prevailing winds, demonstrating for the first time that prevailing winds play a dominant role for houses within 3 miles of a CAFO, while size (animal units) plays a dominate role for houses beyond 3 miles from a CAFO. Additionally, this study finds that the impact of swine CAFOs is farther reaching than previous studies report; CAFOs can reduce the value of houses, albeit by a small amount, as far as six miles away.

Additional research remains to be done. In particular, the impact on houses located very close (within two miles) to a CAFO is extremely difficult to determine, because so little data are available. In fact, the impact could be so dramatic on these very close houses that they do not sell, due to the lack of willing buyers and/or the owner refusing to accept an offer that is a fraction of what its house specific variables would otherwise suggest. In addition, a comparison of the total loss in house values to the cost of odor abatement is also worth study. It might be less expensive for CAFO owners to compensate home owners for their loss than to implement odor abatement techniques. If transaction costs are sufficiently low, assigning tradable externality-free rights to homeowners or externality-creation rights to CAFO owners represent market-based solutions that could be implemented to help mitigate the negative impacts associated with swine CAFOs.

Finally, the techniques developed in this study can easily be adopted by others who also study the impact of a particular land use on the value of nearby properties. The management of selection bias will always improve the results. Building spatial correlation into the error term will also help reduce biases in the estimates of the coefficients. The concentric circles technique can help deal with the problem of small sample sizes and influential observations. The wind angle measure introduced in this study could be adopted by others who study the impact of any sort of phenomenon that is carried and influenced by prevailing winds.

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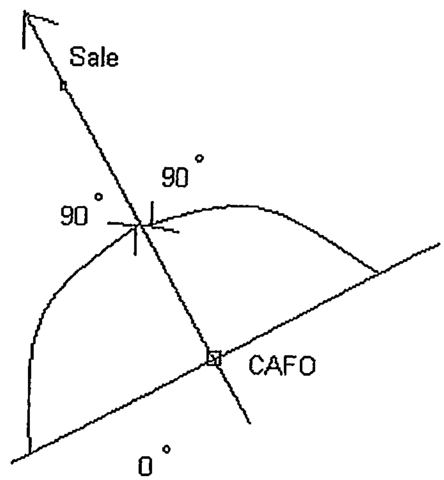
Figure 1 Definition of Wind Angle Variable

Warmer Months: March 22 to December 2 – SSE Predominate Wind Direction:



Colder Months: December 1 to March 21 – NW Predominate Wind Direction

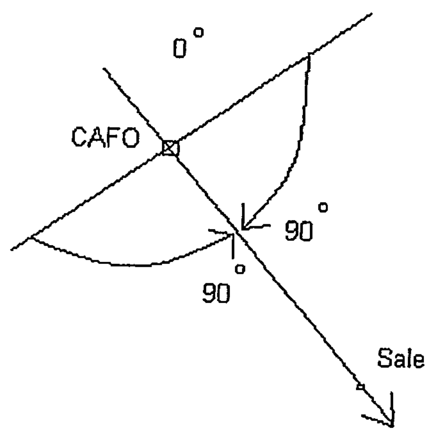


Figure 2 Locations of Sales, CAFOs, and City Boundaries

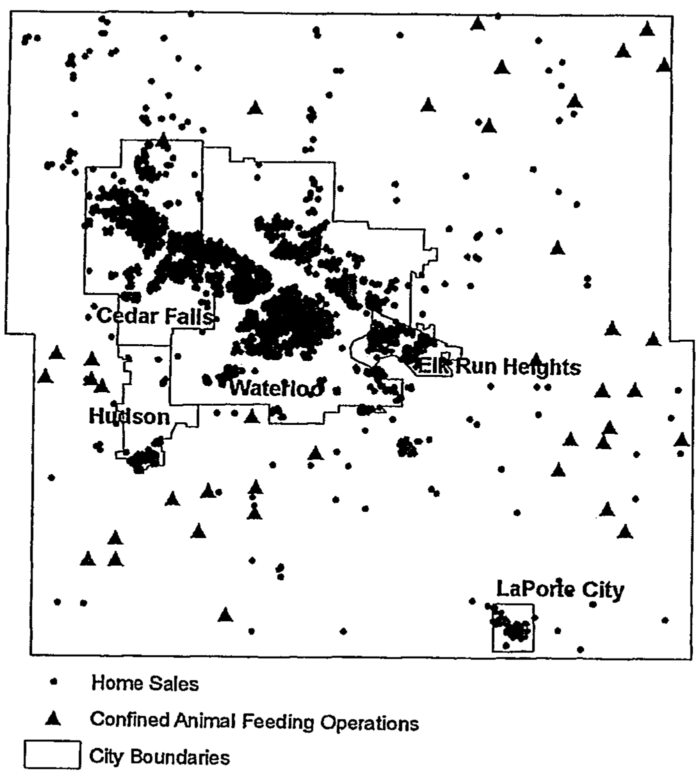


Table 1 Summary Statistics of Data

Variable	Mean	Std Dev	Minimum	Maximum
Sales Price	108456.38	60919.30	32208.96	399512.37
Structural:				
Living Area	1182.67	442.2736094	502.7032320	3904.95
Year Built	1953.08	25.9301497	1852.0	2003.0
N. Rooms	5.4905531	1.2581963	4.0000000	11.000000
Lot Size	3.0445554	18.499110	0.0706512	365.0374679
Time:				
Date of Sale	2.6873789	1.3821553	0	4.88
Season	0.2006183	0.4004974	0	1
City:				
Cedar Falls	0.2858124	0.4518393	0	1
Waterloo	0.5879423	0.4922477	0	1
Hudson	0.0197527	0.1391611	0	1
Elk Run H.	0.0475782	0.2128902	0	1
LaPort City	0.0204397	0.1415110	0	1
Distance to:				
Cedar Falls	7.1481845	3.6729565	0.1600000	25.5900000
Waterloo	3.7208159	2.8765304	0.1600000	17.9400000
John Deere	6.5147149	2.5233630	0.4400000	20.2500000
University	5.5595706	3.5354120	0.4700000	23.7100000
CAFOs:				
Count	0.0269667	0.1771941	0	4.0
Distance	4.0029612	1.0978247	0.1600000	6.5900000
Wind Angle	33.952926	30.803978	0	89.989
Animal Units	977.5385	508.9314	156.0	2005.0
North	0.709550	0.454009	0	1
Manure App	0.2821	0.4559	0	1

NOTES:

a. Sales Price is measured in dollars
b. Living Area is measured in square feet
c. N. Rooms represents the number of rooms in the house
d. Lot Size is measured in acres
e. Date of Sale is measured in years beginning at Jan. 1, 2000
f. Season = 1 for colder months (Dec. 1 thru March 21); 0 for warmer months
g. City variables are bi-variant (0,1)
h. Distance to variables are measured in miles to the center of each destination
i. Count measures the number of CAFOs within 1.5 miles of the house
j. Distance represents the distance to the nearest CAFO
k. Wind Angle represents the extent to which a house is downwind from the nearest CAFO
l. North = 1 for sales north of being downwind from the nearest CAFO; 0 if south
m. Manure App = 1 for broadcast; 0 otherwise (injection, etc.)

[1] The authors thank the Black Hawk County Board of Supervisors for providing the house sales data used in this study. The opinions expressed in this paper should not be interpreted as representing the opinions of the Black Hawk County Board of Supervisors.

[2] The effects of proximity to the second, third, etc. closest CAFO are not addressed in this study.

[3] Specifically, the PROC MIXED procedure in SAS is used to fit all of the models.

[4] Specifically, S-Plus is used to derive the seed values for the range, sill, and nugget in each model.

COMMUNITY IMPACTS OF CAFOs: PROPERTY VALUES

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Dated 4/2008

3

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ID-363

SOCIAL/ECONOMIC ISSUES

Community Impacts of CAFOs: *Property Values*

EXPERT REVIEWED

Roman Keeney

Agricultural Economics

Dean Jones, former Extension Educator, conducted the interviews for this survey information.

This publication is one title in the *Concentrated Animal Feeding Operations* series.

To view the entire series, visit <http://www.ansc.purdue.edu/CAFO/>.

As rural communities debate the siting of CAFO operations, an important distinction must be made between community-wide impacts and those that impact individuals. Improvements in the income tax base or CAFO deterrence of other industries are likely to be shared economic impacts across all residents. An often noted impact that is not shared in the same manner by all residents is the impact on property value. In general, those who are closest to a potential CAFO site feel they will disproportionately suffer financial harm as their property loses market value.

The objective of this publication is to review estimates from academic studies on CAFO impacts on house prices and discuss the implications of these for Indiana communities facing CAFO siting decisions.

Overview of Studies

Rural non-farm families tend to have a majority of their wealth in their home and property. A nearby CAFO may cause deterioration in the market value of this asset due to loss of amenities or the risk of water or air pollution derived from the CAFO.

Ulmer and Massey provide a review of the academic literature on property value impacts of animal feeding operations. They discuss the effects of distance, animal numbers, and management practices as sources of impact on residential property values. Property price impacts (percentage changes) from two of the studies reviewed by Ulmer and Massey and two unpublished studies are reported in Table 1. We note that the impacts as estimated in these studies are quite uncertain ranging from a six percent reduction to a four percent increase in house prices.

Market prices for homes are expected to decline the closer the home is to the CAFO, and each of the studies in Table 1 provides evidence of this. Instances of positive impacts on home prices typically occur because: 1) the area is already well-populated

Table 1. Estimates of property value loss from location of animal feeding operation

Authors	State	Animal Type	Change in Property Price
Bayoh, Irwin, Roe	Ohio	Various	Small
Herriges, Secchi, Babcock	Iowa	Swine	-6% to +4%
Kim, Goldsmith, Thomas	North Carolina	Swine	-2%
Palmquist, Roka, Vukina	North Carolina	Swine	-3.6% to 0 %

Notes: Estimates reflect the percentage reduction of the price of a house when a CAFO (1000 animal units) is located at a distance of 1 mile from the home. The exception is Herriges, Secchi, and Babcock whose range of estimates is for a 1.5 mile distance from the home. Kim, Goldsmith, and Thomas use assessed value of the home rather than a purchase price.

with livestock, or 2) that the purchases of homes were made by the CAFO operator or those who work on the CAFO.

An interesting point raised in the study of Iowa property values is that larger operations (in terms of animal numbers) tend to be newly built and employ best available technologies for dealing with waste and odor. As a result, it may be that larger operations are not necessarily more harmful than smaller feeding operations.

Implications

The obvious implication from the estimates in Table 1 is that individuals will realize different impacts from the location of a CAFO. Each of the studies report that property value impacts diminish to negligible effects beyond a distance of two miles. One study considered the prevailing winds direction. A downwind home will realize a significantly larger decline in value relative to a home upwind that is the same distance from the CAFO (Herriges, Secchi, and Babcock).

The potential inequities of these different factors of home location indicate that communities and operators must choose to site CAFOs in a manner that either minimizes differential impacts on home values or compensates those individuals disproportionately impacted. Appropriately discounting property value assessments for taxation purposes represents one avenue discussed by Ulmer and Massey that has been handled through court cases.

Concluding Comments

Disproportionate impacts on community residents' wealth through property value changes represent a source of conflict in community decisions regarding CAFOs. An important step for communities when considering the siting of a new CAFO is to understand the unequal wealth impacts may be realized and formally address how and to what degree a concession or compensation might be made to those with the greatest potential for loss. Any proposed economic redress to the CAFO siting would then need to be incorporated into discussions of the overall benefits and costs being considered by the community as a whole.

Unfortunately, academic studies of property markets offer only the general conclusion that there will be negative impacts on some house prices. Several of the studies indicate factors that underlie different impacts for different areas include the general acceptance of agriculture and characteristics of the typical buyer in the local residential market.

With little general guidance available, community leaders may need to conduct or commission local studies of the magnitude of potential impacts given the technology and scale of the proposed CAFO. Local realtors, appraisers, or community officials involved in property assessment represent local resources that bring different expertise and could be used to find a useful consensus.

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PURDUE AGRICULTURE

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SOCIAL ECONOMIC AND CULTURAL IMPACTS OF LARGE-SCALE CAFOs

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Social, Economic, and Cultural Impacts of

Large-scale, Confinement Animal Feeding Operations

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I was recently asked by a rural advocacy group in Missouri to list some logical reasons why rural community leaders should be concerned about the impacts of livestock factories on their communities? I considered this to be a reasonable request and thus developed a list of reasons why I think rural residents should question whether or not they want large-scale, corporate hog farms to locate in their communities. Those reasons seem to make a logical starting point for a paper concerning the social, economic, cultural impacts of large large-scale, confinement animal feeding operations (CAFOs) on rural communities.

As I indicate in my response to the request, there is no scientific consensus on this issue. Thus, there is no set of scientific "facts" to either prove or disprove the validity of these concerns. Research exists to support many of the concerns on my list, even though they cannot be proven. However, most of the concerns on the list are based primarily on logical reasoning and common sense. Some may dismiss these "logical" concerns as illogical, uninformed, or inconsequential. But, such assessments simply represent differences in "beliefs," not proven facts or some unique knowledge of reality. The people of rural communities have a right and responsibility to weigh the evidence and logic on both sides of this issue and to make their own decisions.

<u>Top ten reasons for rural communities to be concerned about large-scale, CAFOs</u>

A "top ten list" wasn't chosen just to be cute or catchy. Ten is enough to get the point across, but not so many as to overdo discussion of the issue. Also, I wanted to start at the bottom of my list and work my way to the top.

Concern #10. Hogs stink

Odor is at the top of the list for many opponents of large-scale hog farms. The most vocal opponents tend to be those affected most directly – those who wake up most days to the smell of hog manure. To a hog producer, hog manure may "smell like money," but to the neighbors, it just "smells like hog manure." There are legitimate human health concerns associated with air quality surrounding large hog operations. Thus, the odor problem goes beyond the very real nuisance of living with stench in the air. Odors associated with giant hog farms affect the lives of people for "miles around," not just those on adjoining farms. Few would be willing to stay in, or move into, such a community if they have an opportunity to locate elsewhere. Odor ranks only 10 on my list because something could possibly be done to mitigate its impacts, such as using odor-reducing technologies, compensating those most affected and locating facilities so as to minimize impacts of the greater community.

Concern #9. The work is not healthy for people

A large confinement hog facility is not a pleasant place to work. Known health risks are associated with continuously breathing air that arises from manure pits in confinement hog facilities. Health problems cost money in lost wages and health care costs. But more important, an unhealthy workplace can destroy peoples' lives. History has proven that people will choose to work in dangerous work environments when they are desperate for jobs. Health risks can be life threatening, so I rank worker safety above odor problems. But as in the case of odor, health problems can be mitigated by protecting workers from the noxious fumes, by limiting exposure, and by keeping people with other health problems out of confinement facilities.

Concern #8. Piling up too much "stuff" in one-place causes problems.

If you spread out the hogs and let hog manure lay where it falls in a pasture, it doesn't bother anyone very much. But if you start collecting it, flushing it, spreading and spraying it around – all normal practices in confinement hog operations – it becomes air pollution. Water pollution also is a symptom of the same basic problem – too much manure in one place. The difference between the hog lagoon spills, such as those in Missouri and North Carolina, and the normal runoff from a hog pasture is a simple matter of concentration. When you put a lot of hogs in the same place, you have to collect and store the waste. If it gets into the ground water or gets flushed into streams, it kills fish, clogs streams and lakes with algae, feeds water born disease organism, and wreaks havoc in the environment.

In addition, manure on diversified hog farms normally is spread back onto cropland where the feed grain was grown. Most of the nutrients used to grow the crops are returned to the soil. But, when feed grains from specialized crop farms are shipped to distant hog-factories, the nation's future productive capacity is being stacked up and flushed out into places where crops can't grow. We can treat the symptoms – air pollution and water pollution – but the basic problem of piling up too much stuff is inherent within the system of large-scale, concentrated production.

Concern #7. Consumers have little if anything to gain.

Large-scale, corporate hog production is frequently justified to the general public as a more efficient, lower cost, means of producing higher quality pork. The facts of the situation simply do not support such a claim. The average consumer spends just over 10 percent, a dime out of each dollar, of their disposable income for food. About 10 percent, a penny out of the dime, is spent for pork. The costs of live hogs make up only about 35 percent of that penny. The rest goes for processing, packaging, advertising, transportation, and other marketing costs.

Farm record data have shown that costs of large-scale hog operations are only slightly lower than costs of "average" commercial hog producers. Even if production costs were five percent less, about $2/cwt of live hog; the "maximum" savings to consumers would be less than two cents per dollar spent for pork at retail. At best, total food costs would be two-tenths of one percent less and consumers on average would spend only "two-one-hundredths of one percent" less of their income for food. Any savings would be lost in rounding error in consumer food cost statistics. With a handful of large hog producers and packers gaining control of the industry, it seems far more likely that in the long run pork prices would go up rather than down as a consequence of further industrialization.

The argument that factory pork would be higher in quality doesn't hold either. Pork would be more uniform because it would all come from the same basic genetic stock, as is currently the case with chickens. However, consumers have different tastes and preferences – different perceptions of quality. Making all pork "the same" would not necessarily please more consumers. Greater profit for producers and processors, not lower costs or higher quality, is the driving force behind the current trend toward industrial hog production. The only ones who really need to shave another penny or two off production costs are those who are trying to export more pork into highly competitive world markets. That doesn't include many hog farmers or pork consumers. So, why should the general public support industrial hog production?

Concern #6. Continuing regulatory problems are inevitable.

Without regulations, big hog operations will impose costs on their neighbors – air pollution, water pollution, and others – that are not part of the historic costs of producing hogs. It will cost money for hog factories to deal with "externalities" such as air and water pollution. No "bottom-line" driven hog operation will incur those costs unless they are forced to do so by government regulations – federal, state, or local.

Family farmers are people with human feelings and values, and most feel some sense of responsibility to their communities and the environment. Family farmers at least have personal incentives to be stewards of the environment and good neighbors, regardless of how they choose to behave. Public corporations have no such incentives. They are not people. Corporations have no heart or soul. Stockholders often are so detached from their investments they don't know or care what stocks they own – just as long as they make money. Local managers and workers may be good people who really care about the community, but when it comes to keeping their job, they must put profits and growth ahead of community. Professed corporate support of local communities, by necessity, can be nothing more than another strategy for profit and growth. Thus, government regulation and continual conflict are an inherent fact of corporate life.

Concern #5. Hog factories destroy public confidence in agriculture

Over the decades, family farmers have built up a vast treasure of public confidence and good will. Many people in the cities either grew up on farms or have parents or other close relatives whom either now are or once were family farmers. The "farm family" conjured up images of people who are hard working, moral, honest, solid, dependable, trustworthy, caring, and responsible. These images have been a valuable source of wealth for farmers – although not widely recognized as such.

Farmers have been awarded special privileges, exemptions, and variances under a whole host of public policies – from taxation to environmental regulations – because they were trusted to behave in the public interest. Support of "family farms" has been an important part of the rhetoric of every farm bill that has passed congress. Farmers have also enjoyed a special status "as people," apart from any monetary benefits. They have been respected and trusted. However, bad publicity surrounding large-scale, corporate hog production is using up the farmer's stock of public confidence and good will at an alarming rate. Negative stories have appeared on every major television network over the past few years. When Ms. Magazine runs a feature article on the ills of corporate hog farming, as they did in 1997, we can conclude that the story has just about made the full circuit of public opinion shapers. Family farms will be paying for this loss of public trust for decades, if not forever.

Concern #4. Future of the community is turned over to outside interests.

Rural people need to take charge of their own destinies if they expect to sustain a desirable quality of community life for themselves, their children, and future generations of rural Americans. Quality of life is about much more than just creating more jobs and making more money. Quality of life is also about positive moral and social values and being responsible caretakers of the community as a place. Sure, people need jobs and need to make a decent living. But, jobs and high wages didn't save the cities from decline and decay and jobs won't save rural communities either. When an apparent solution to a problem comes from someone else, from outside, you can just about bet that the benefits will be going to someone else from outside as well.

Some rich and powerful outsiders have their own problems, and they have their eyes on rural communities as places to solve them. Sparse population, trusting people, and lack of jobs in rural areas are seen as ideal opportunities. They are looking for someplace to "dump stuff." An Industrial society creates a lot of "trash," whether in the form of garbage, toxic chemicals, or hog manure. Most "outsiders" promoting rural development schemes have something they need to "dump." Jobs just aren't enough compensation for turning a community into a "dump." Rural people need to take control of their own destiny and build the kinds of communities in which their children and their children's children will choose to live and grow. The solutions to the problems of rural Americans are in the hands, hearts, and minds of rural people themselves, not in outside investment and corporate control.

Concern #3. The decision making process can rip communities apart.

The process of decision making may be more important than the decision itself. Anyone who has been a part of a family has experienced this first hand. The memory of an act that triggered a family feud has long since faded, but the feud goes on. Feuds result from a loss of confidence and trust, regardless of the context within which the loss takes place. The large-scale, corporate hog farm issue is one of the most contentious issues to confront rural America in recent history.

The social fabric of rural communities has been ripped apart by controversy surrounding the introduction of large-scale, corporate hog operations. There seems to be no middle ground. Some people seem determined to bring in the big hog operations, by almost any means, and others seem just as committed to keep them out, by almost any means. Almost everyone eventually seems to feel obligated to take sides. The larger question in such communities is not whether the hog factories come in or stay out, but can the community ever heal the wound left by the fight?

A healthy, unified community can deal with almost any problem, including a large-scale corporate hog farm on the outskirts of town. A sick, bitterly divided community is incapable of much more than survival, regardless of its other advantages and opportunities. The future of rural America depends on communities of people being able to work together for their common good. The divisiveness of the decision making process, presumably, could be avoided. But, the consequences of failing to do so are so destructive that it ranks near the top of my list.

Concern #2. Hog factories degrade the productive capacities of rural people.

Factories "use up" people. Assembly line work is "non-thinking" work. When you work on an assembly line, you simply do what you are told as fast as you can for as long as you can. I know. I have been there. Large-scale hog operations may not be assembly lines, but the principle is the same. Big hog operators do not want people who know anything about raising hogs. They want people who can be trained to do what they are told to do without thinking. An experienced hog farmer might start thinking, asking questions, and mess up their process. Hog factories, like other factories, are looking for people who are dependable, who know how to carry out orders, and will work hard for a little money.

On balance, large-scale, industrial hog operations destroy more jobs than they create. A driving force behind industrialization is to substitute capital and technology for labor and management – to make it possible for fewer people to produce more. Large-scale hog operations concentrate the jobs created in one place and call it economic development. The jobs lost elsewhere are ignored or denied. The numbers of independent hog farmers displaced elsewhere will be greater than the number of jobs created in new large scale hog operations. Hog factories replace more independent hog farmers with fewer assembly line workers.

Other kinds of factories have come to rural America in the past. When these factories have found people in other regions, or in other countries, who would work even harder for less, they moved on. Corporately owned factories have no roots. They leave behind a workforce that doesn't know how to do anything other than what they are told. Intelligent, thinking, capable, independent people are transformed into detached, non-thinking people who may be psychologically incapable of earning a living without depending on someone else to tell them what to do. Our cities currently are plagued with such people – people whose capacities have been degraded by factories long since gone. It just doesn't seem to make sense to do the same thing to rural people. When we replace independent, family hog farmers with hog factories we are degrading the most valuable resource rural areas have to support future development – rural people.

Concern #1. Tomorrow's problems are disguised as today's solution.

My number one concern regarding large-scale, corporate hog operations is that rural communities will see them as "the solution" to today's problems without seeing them as a potential "source" of problems for tomorrow. Maybe there are some communities so desperate for jobs that it makes sense to take the risks. Maybe they feel they have to do something today to give them a chance to do something better tomorrow. But, hog factories are a short-run solution, at best, that may create more long run problems than they solve today. Low-wage, assembly-line-like jobs should be viewed as a stop gap strategy suitable only for communities with no other options. Sooner or later non-thinking jobs will be done somewhere else on the globe, where people will work harder for less money and are accustomed to doing whatever they are told – by those who have no other options. In the longer run, all non-thinking jobs will be done using computers and robots – not by people anywhere.

The real opportunities for people to lead successful lives in the future will be in "thinking" work. The human mind is uniquely capable of complex thought. Almost anyone is "smarter" than a computer. But, people need to develop their unique human abilities to think. We need to accept the responsibility for thinking and for creating thinking jobs for ourselves and for others. As long as rural people think their problems are solved, or will be solved by someone else, they see no incentive to begin doing the things they need to do to ensure the future of their community.

The primary advantages for rural areas in the twenty-first century will be the unique qualities of life associated with open spaces, clean air, clean water, scenic landscapes, and communities of energetic, thinking, caring people. Communities that sacrifice these long run advantages for short run economic gains may have a difficult time surviving in the new century.

Thus, my number one concern is that large-scale, corporate hog operations are tomorrow's problem disguised as today's solution. They may keep rural people from doing the things that need to be done today to ensure the future of their communities. Large-scale, corporate hog operations will not create communities where our children and their children will choose to live and grow. Communities with a future must take positive actions today to ensure a desirable quality of life for themselves, their children, and rural children of future generations.

Why Do Rural Communities Accept Confinement Animal Feeding Operations?

Admittedly, there are reasonable arguments that can be used to support bringing large-scale confinement animal feeding operations (CAFOs) into a rural community. Community leaders who support such operations typically argue that people in their community:

a. Need jobs in to replace those lost to globalization,
b. Need a higher tax base to provide rural services,
c. Need to bolster their declining agricultural economy,
d. Know that other communities will accept these operations if they don't,
e. Feel that they can't stand in the way of progress,
f. Believe big operations can better afford modern pollution prevention technologies,
g. Feel that local opposition is just another case of "not in my backyard," thinking.

There are logical responses to each of these arguments, but each also contains elements of truth. One thing nearly all pro-CAFO arguments have in common is their foundation in short-run, self-interest economics. They are based on a deeply held faith that the market place is the best means of allocating resources – whether it is allocation of people among alternative occupations, land among alternative uses, money among investments, or people among communities. Those things possible and profitable shall be done. People have a right to protect themselves and their property from damage caused by others, but beyond that, the economics of the marketplace shall prevail. A community is nothing more than a collection of individuals that happen to be located in geographic proximity to each other. These are typical assumptions of self-interest economics.

After all, corporate investors are putting their money into CAFOs because they expect to make profits. Investments create jobs and enhance the local tax base. If CAFOs are more cost efficient than smaller farming operations, even if marginally so, traditional family farmers will inevitably be forced out of business – so the argument goes. Why not give local farmers a chance to go to work for a profitable agricultural corporation? We know these Corporations are going to invest somewhere, so it might as well be here. There are always costs associated with anything that generates benefits. The opponents just want someone else to bear those costs.

They reason that if environmental problems arise, it will be easier to work them out with a few large operations than many small ones. The big operations have the money to invest in the modern waste handling facilities that ultimately will be required of everyone. The technology is available, it's profitable, so it's both futile and foolish to stand in the way of economic progress. The people who are opposed to these operations are accused of being out of touch with economic reality. Opponents of CAFOs are labeled as Luddites – as people who oppose progress or just want to keep things as they are.

If self-interest economics prevail, there is every reason to believe that CAFOs eventually will totally dominate animal agriculture in America. And, corporations will locate CAFOs pretty much wherever they choose, regardless of the ecological and social consequences. They will avoid locating them in heavily populated areas to minimize nuisance law suites. But, money invested in CAFOs will seek its place of highest return. The only way to successfully challenge this outcome it challenge its basic premise – the right of private profits to prevail over public good – and to uphold the rights of people to prevail over the pursuit of profits in protecting their communities and shaping their destinies.

Sustainability: The Challenge to Land Use Economics

Current land use decisions in the United States have their foundation in economic theory as it relates to the concept of private property. Persons who hold ownership rights to property may do with it pretty much as they see fit, including exchange ownership rights with others, as long as it does not interfere with the private property rights of others. Any restrictions on individual land use are limited to uses that might affect the use rights held by other individuals.

With relatively minor exceptions, land use decisions are determined by the economics of the market place. Provisions are made through laws of eminent domain to acquire private property for public use, without the consent of owners, but not without just economic compensation to current landowners. Land uses of a criminal nature, deemed to be of clear public harm, may be restricted without compensation. Land use zoning may restrict land use as well. But in reality, economic considerations commonly dominate planning and zoning decisions. The question becomes, how can economic development be maximized with the minimum negative impact on community residents. Requests for changes in zoning are typically motivated by a desire to put land to a higher economic use. Opposition to changes typically is motivated by the desire to protect private property rights. It is a rare community that uses the tools of planning and zoning to ensure the long run ecological and social well being of the community as a whole.

So, with minor exceptions, private property may be put to its highest economic use. The concept of highest economic use gives legitimacy to competing private property rights, but commonly ignores or denies any right of the community, or public as a whole, to participate in all land use decisions. Economic theory treats a community as a collection of individuals, not as an entity with rights separate from, or in addition to, those of individuals of which the community is composed. In addition, conventional economics gives no consideration to potential ownership rights of future generations. Rights of intergenerational transfer of ownership are based on the premise that to prohibit or limit such transfers would unjustly restrict current private property rights. Free market economics makes no provision for future generations, other than those reflected in the self-interests of current decision-makers. And economics drives land use decisions.

The question of long run sustainability presents a serious challenge to conventional economic thought as the foundation for land use decisions. Over the past decade, many different people have defined sustainable development, of which sustainable agriculture is but one part, in many ways. However, the underlying theme of nearly all such definitions is one of intergenerational equity – a responsibility to meet the needs of the current generation while leaving equal or better opportunities of those of all generations to follow. In more common language, sustainability development applies the Golden Rule across generations – doing for future generations as we would have them do for us.

The three cornerstones of sustainability are ecological soundness, economic viability, and social justice. The three are not separate goals or objectives, but instead are three separate dimensions of the same whole -- as with the three dimensions of a box; height, length, and width. Any object lacking any one of those three dimensions quite simply is not a box. Any system of development that is not ecologically sound *and* economically viable *and* socially just quite simply is not sustainable over time. All are necessary and none alone or any pair is sufficient to ensure sustainability.

Thus, sustainability requires that we look beyond the economics of short-run, self-interest to the broader set of issues affecting quality of life or human well being over time. Sustainability requires that we broaden our economic thinking to consider the long run health and productivity of the natural ecosystem, not just the optimum means by which it may be exploited for our short-run gratification. Sustainability requires that we broaden our economic thinking to consider the well being of the community, or society, as a whole, not just sum the welfare of individuals who make up a community or society. The economics of self-interest is an important dimensions of sustainability, but it is but one among three. Things ecological, social, and economic must be considered as complementing dimensions of the same whole, not as competing objectives that can be pursued separately.

<u>Land use decisions: The long run fallacies of short run economics</u>

The inadequacies of short-run economics in guiding long run decisions can be made clear through an illustration using fairly basic economics. Those who have never taken Economics-101, need not struggle every detail of the charts and graphs. They only need to be aware that the conclusions drawn from them make economic sense. The reader may feel free to skip ahead if they get bogged down in details. However, those who skip ahead may wish to return to this section later as it provides the theoretical foundations for some fairly bold conclusions in later sections of this paper.

The chart and graph in figures 1 and 2 were adapted from those in a standard economics textbook. They were designed to illustrate the stages of economic production. In this case the question is how much variable input -- things such as pesticides, fertilizer, or labor -- should be applied to a given amount of fixed resources -- such as land. The illustration is based on 3 units of fixed resources, say 3 acres of land, and examines the potential use of from 1 to 8 units of variable resources, say from 100 lbs. to 800 lbs. of fertilizer on that land. As the amount of variable input applied to a given fixed resource increases, by definition, the amount of fixed resource per unit of variable input declines. While the ratio fixed/variable ratio has little intuitive meaning at this point, it becomes important in the discussion of long run decision making. Units of variable input are shown in the first row of the chart in figure 1, and units of fixed resource per unit of variable input are shown in the second row (SRF/SFV).

The top line in the chart traces out a typical total production function for the short run situation (TP SRV). It shows that total production rises fairly consistently, from 10 to 60, as from 1 to 5 units of variable inputs are added. Production peaks at 6 units, levels off, and then declines as more variable input is added. The average production line (AP SRV) shows total production per unit of variable input (TP SRV/Units of Input). The marginal production line (MP SRV) shows the change in total production as each additional unit of variable input is applied to the given fixed resource. For example, going from 2 to 3 units of variable input changes total production from 24 to 39, a marginal product of 15. Plotting marginal product of 15 with 3 units of input rather than somewhere between 2 and 3 units causes some graphical problems that will be clarified later. Note that *average* production peaks at 3 units of variable input, levels out at 4, and declines thereafter. *Marginal* product peaks above variable product at 3 units, declines and drops below average product after 4 units, and drops below 0 as total production peaks and begins to decline.

At this point, the analysis can become a bit confusing, in that we are not accustomed to thinking in terms of "applying" fixed factors, such as land, in the process of production. But when we apply an input to land, we also are applying land to that input. So, the fifth line in figure 1 (TP SRF) is used to show total production attributable to utilization of the short run *fixed* resource, for a given amount of variable input. For example, TP SRF might indicate total production associated with using additional acres of land with a given quantity, 100 pounds, of fertilizer. Note that *total* product attributable to the short run fixed resource is equal to *average* product for the short run variable product. (They share the same line, with overlaid symbols in figure 1.) For example, when 200 lbs. of fertilizer is applied to 3 units of land, the result is 24 units of total production. This represents an *average* product of 12 units of output per 100 lbs. of fertilizer. But alternatively stated, a *total* production of 12 units of output is obtained by using 1.5 acres of land with 100 lbs. of fertilizer.

Note as the amount of variable input applied to the fixed resource increases from 1 to 8, the amount of fixed resource used per unit of variable input (SRF/SRV), drops from 3 (3/1) to .38 (3/8). The average product for the short run fixed resource is calculated the same as for the variable input – total product divided by units of fixed resource (per unit of variable). However, marginal product of the fixed resource must be calculated starting from the right hand side of the chart and working toward the left – the direction in which additional units of fixed resources are added per unit of variable inputs. For example, the amount of land used per 100 lbs. of fertilizer increases as the amount of fertilizer applied to a given amount of land declines.

Coming from right to left, note that the marginal product for the fixed resource declines and become equal to its average product, at its peak, at about where total production attributable to the variable input peaks and marginal product becomes negative. Also note that the marginal product for the fixed resource drops below 0 just beyond the point, going left, where average product peaks and equals marginal production.

These relationships among total, average, and marginal production for variable inputs and fixed resources are not accidental. In fact they are fundamental to economic theory of production. Figure 2 shows general relationships among average and marginal products attributable to any input, such as fertilizer or pesticides, and fixed resource – land in this case. The basic nature of these relationships will hold for any production relationship that is characterized by: (stage I) total production increases at an increasing rate at low levels of input use, (stage II) total production continuing to increase, but at a decreasing rate with additional inputs, and (stage III) total production declining beyond some point as more inputs are added.

Continuous functions used in figure 2 eliminate the plotting problem for marginal product. Note that average product peaks as marginal product drops below average product for inputs. This occurs at the same point where marginal product for land drops below zero, meaning total production from using more land (moving right to left) has begun to decline. Likewise, average product for land peaks as marginal product drops below average product, which occurs at the point where marginal product for inputs drops below 0, meaning that total production from using more inputs (left to right) has begun to decline.

All economically relevant production functions are characterized by these three *stages of production*, although stages I and stage III are frequently not observed in actual practice. Stage II defines the range of *rational* economic production. At any point in stage I, *greater* total production could be achieve by using *less* of the other resources or input – by using less land in stage I for inputs, or by using less inputs in the case stage I for land. If the availability of inputs is limited, it would be economical to let a portion of the land set idle rather than to apply so few inputs per acre as to leave production in stage I. If land were limited, it would be economical to leave some of the inputs unused, even if it were free, rather than to leave land-use levels in stage I. Thus, it is not economically rational to produce in stage I.

Note that stage I for inputs and stage III for land (declining total production) coincide. And stage I for land and stage III for inputs (declining total production) coincide. The end of stage I for inputs (left to right) coincides with the beginning of stage III for land (right to left), and vice versa. It is not economically irrational to accept less from using more when you can have more from using less. So it is not rational to produce in either stage I or stage III for either inputs of land.

This leaves stage II as the only economically rational range of production. Stage II coincides for both inputs and land. Within stage II, both average product and marginal product are positive but declining, and average product is greater than marginal product for both inputs and land. By implication, total production is increasing, but at a decreasing rate. It is not possible to determine the economic *optimum* level of production without assigning prices to production and inputs. But, if there is a profit to be made, it will be made somewhere within stage II, the range of rational economic production.

We can, however, draw some important conclusions regarding optimum land use under some fairly general conditions without specifying prices. As long as prices of inputs are not dependent on how much a given producer buys, which is typical of farming, we know that *minimum input cost* per unit of production will occur at the point of *maximum average product* – the beginning of stage II. The more production per unit of input used, the lower will be input cost per unit of production. We also know that if *inputs were free*, it would pay to increase their use to the point of *maximum total production*, the end of stage II. Any increase in value of production will more than offset a zero increase in cost. The economic optimum within this range depends on the relative prices of inputs and products. Input use will increase as long as the value of the marginal production is greater than or equal to the cost of the additional input.

Implications for Sustainable Land Use

An intuitive grasp for the meaning of the three stages of production, from the preceding section, is sufficient to understand some fairly critical conclusions regarding the economics of land use. From a short-run economic perspective, production should be increased beyond the point of minimum cost, to a point where value of additional production no longer exceeds added cost of inputs. If inputs became cheaper or new technology allows more production per unit of input, the optimum level of input use would move nearer the end of stage II at a higher level of production and profits. As a consequence less land would be required than before to produce any given level of optimum total production.

.his is the economic rationale for the politically motivated "high-yield" farming movement. The basic argument is that if we use more commercial inputs and new production technologies to increase production per acre of land, more land can be set aside for wildlife and other non-agricultural uses. Alternatively, if we rely on less input-intensive farming methods, total production will fall, making it necessary to farm more land to meet the food and fiber needs of people. This would require the use of more environmentally fragile lands, some of which is currently set aside for wildlife. It is not likely coincidental that high-yield farming maximizes input use and is supported by those who sell or promote inputs – thus, the political motivation for its promotion. However, the economic argument is valid -- but only from the perspective of short-run, self-interest economics.

The conclusions are totally different if we instead take a long run, sustainable economics perspective of the land use question. In the long run nearly all the agricultural inputs that are variable in the short run are fixed. For example, fossil fuels, commercial fertilizers and pesticides, and machinery are all derived from finite, non-renewable stocks of natural resources. Thus, their long-run supply is fixed, not variable, even though their short run use may be variable.

In the long run, our only variable resource is solar energy. Living organisms, including people, represent renewable resources, but living organisms are dependent on finite natural resources as well as solar energy. Every productive resource on earth can realistically be depleted over some finite period of time. But, the continuing supply of energy from the sun is expected to continue for lions of years into the future.

Geographic space is required to capture solar energy, at least for agricultural use. Land represents space. Thus, land – as space – serves as a proxy for the only long run, *variable* resource. Of course, land has characteristics other than space -- such as organic matter, texture, and water holding capacity – which may influence its productivity and value. But, the non-spatial aspects of land are finite, and thus, may be depleted over time. Land as space, while fixed in total at any point in time, represents a virtually infinite supply of solar energy that may be utilized in varying quantities over time, and thus, represents a *variable* long run resource.

Ironically, those things that are variable in the short run are fixed over the long run, and the one thing most fixed in the short run, space, represents the only variable long run resource. As we should expected, that which appears to be optimum from a short run perspective appears to be far from optimum when one takes a long run perspective.

Returning to stages of production, if solar energy is considered the only variable resource and it is free, the economic optimum will be at the *end* of sage II for land – the point where returns from using additional space for production peaks and begins to decline. Any increase in solar use up to this point will result in a marginal increase in production greater than 0 and it will add more to long-run value of production than to costs, regardless of price of the product. This point of optimum land e will coincide with the *beginning* of stage II for inputs – the point at which average product for uts is maximum and average cost of production is minimum. This result can be expanded to conclude that *optimal long-run use of all finite inputs requires they be used at their point of maximum average product and minimum average cost.* Quite logically, maximum production per unit of input, per period of time, will result in maximum total production over time, for any finite input.

Conventional economic theory claims that minimum average cost of production is ensured by competition. If any operation becomes clearly profitable for existing businesses, new businesses will become involved in the same type of operation. The market will not expand accordingly, thus limiting the average output of each operation further as the number of operations increases. This process is assumed to continue until profits are dropped to a level sufficiently low so as to discourage any new operation from entering the market. At that point, production of each operation will be reduced to the point where marginal product is equal to average product and average cost is minimum.

However, this conventional economic assumption has several critical flaws. The most obvious is the lack of competition, in the classical economic sense, in many of today's markets. The persistence of 10-20 percent annual returns of investment in the food industry, for example, is clear evidence that profits are not always passed on to consumers through competition. However, even in competitive economic sectors such as farming, competition does not ensure minimum costs of production. Successive innovations force farmers to continually move from adoption of one new technology after another, limiting the competition among farmers using the same technologies and preventing markets from reaching their theoretical competitive equilibrium.

Even more critical flaws of conventional economics relate to assumptions concerning the nature of fixed and variable resources. In the short run economic situation, fixed resources, such as land, are assumed to have no cost. By assumption, they have no alternative use within the short-run timeframe. Without this assumption, the cost of fixed resources would result in a competitive equilibrium at some level higher than the point of maximum average product. The value of the marginal product attributable to the fixed resource would drop below its price or marginal cost (moving right to left in figure 2) at some point prior to the end of its stage II, preventing markets from reaching their competitive equilibrium. In the short run, land might be considered fixed, and thus, treated as free. But in the long run, land in never a free economic resource. Land will always have a positive price in a market economy, because less land will always be available than there are people who want to use it.

In the conventional economic *long run*, all inputs and resources are assumed to be variable – a critical flaw in economic thinking as indicated earlier. However, this assumption is necessary to support economists' claims that competition will force all enterprises to operate at their point of minimum long run average cost. But if all resources were variable, land obviously would have a positive cost or price, as it can not be assumed to be free simply because it is *fixed.* As a result, the conventional long run competitive equilibrium would result in over-utilization of non-renewable inputs and under-utilization of land. So, market competition does not ensure efficient land use in short run and virtually ensures the misuse of land over the long run.

So where does this leave the argument for high-input, high-yield agriculture? The only logical conclusion is that high input use, while resulting in high yields in the short run, simultaneously depletes finite stocks of inputs at higher than optimal long run rates. The result is lower that optimum total production over the long run, and ultimately, greater than optimal reliance on solar energy, or land use, as input stocks are depleted. In the long run, more land will be required for agriculture, leaving less land for wildlife and other uses, because productive inputs will have been prematurely exhausted. Thus, high-yield agriculture makes economic sense if one is pursuing short-run self-interest, but is economic nonsense if the goal instead is long run sustainability.

Implications for CAFOs in Rural Communities

So what does all this mean for confinement animal feeding operations in rural communities? First, applying increasing amounts of fertilizer per acre of cultivated farm land is conceptually no different from putting increasing numbers of animals on a given numbers of acres, or an increasing number of CAFOs in a given community or county. In economic terms, both imply increasing quantities of short-run variable inputs – feed, fuel, medication, labor, etc. – applied to a given quantity of short-run fixed resources – in this case, land. And, short run economics will dictate that animal numbers be increased as long as each additional unit of production – increase in size or number of CAFOs --adds more to total value of production than it adds to total costs.

For large-scale operations, costs of production may rise as size increases because feed and other inputs may have to be shipped in and products shipped out from and to increasingly distant locations. But in reality, something other than economic scale of production typically limits the size and number of CAFOs in a given area. Costs associated with such things as foul odors, water pollution, worker health, displaced farmers, degradation of human potential, and destruction of communities are all considered to be "externalities," if considered at all, in short-run, self-interest economics. The limit of size typically is not one of internal economics, but rather one of external pressures.

External costs, by definition, are costs not imposed by the market place. Thus, those who are damaged must impose such costs – through law suites, government regulations, and social pressures from the surrounding community. External costs typically limit the growth of CAFOs within any given area. But, the economics of self-interest provide the constant and relentless motivating force for those who operate CAFOs to do the things that result in law suites, to violate government regulations, and bribe and coerce the community into accepting their presence. CAFOs almost always see opportunities to increase profits if external constraints can be overcome, avoided, or removed.

The existence of externalities cause those who operate CAFOs to choose those areas least willing and able to impose external costs, which allows them to operate as near as possible at the short-run, self-interest economic optimum size. Thus giant animal feeding factories have been located in remote, economically depressed rural areas. It all makes logical short-run, self-interest economic sense. But, it is all long run, sustainable economic nonsense.

What can rural communities do?

Rural people must become actively involved in shaping the destiny of their communities. They cannot rely on some "invisible hand" of economics to create a positive future. The "invisible hand" has been severely crippled, if not cut off, as an economy made up of small proprietorships has been replaced by an economy dominated by large corporations. Rural people must assert their right put their long run, community interest ahead of the short-run, self-interest of those who invest in and operate CAFOs. Such operations cannot even be justified on economic grounds, when one takes a long-run perspective. Nor can the impacts of CAFOs on environmental quality and social justice be tolerated if communities are concerned about their long-run sustainability.

Markets cannot be allowed to allocate the use of land as space. This is the most important people – for those uses with impacts that fall within the realm of the community of interest. But, many uses of land as space have impacts on future generations, and future generations cannot vote. Such land use decisions must reflect our fundamental values concerning the responsibilities of being human. Such issues cannot be resolved by economics or politics; they rest on a fundamental code of ethics or morality. They arise out of a consensus of what is fundamentally right and wrong.

Many issues concerning the natural environment are fundamentally moral or ethical issues. We should not be buying and selling pollution rights, because no individual has the moral right to pollute in the first place, and thus, has no right to sell it. Businesses may argue that society has given them that right, through the political process. But, no society has the right to pollute, so it cannot convey that right to a business or anyone else. Pollution of the environment is fundamentally, morally wrong, the same as it is morally wrong to kill, to steal, or enslave. The environment can assimilate some level of waste, as society can tolerate certain amounts or kinds of killing, stealing, or enslaving. But, those things are still morally and ethically wrong, regardless of the ability of society to survive them. We don't condone or encourage them by allowing people to openly buy or sell the right to enslave another person, nor vote on whether one person should be allowed to kill another for personal reasons. We cannot prevent pollution, but is always morally wrong to degrade the natural environment.

It is also morally wrong for one person to exploit another person for personal, economic gain. The short-run economics of self-interest makes no provision for avoiding such exploitation. Those who have fewer opportunities are forced to do the jobs that others can avoid at wages lower than others would be willing to accept. Pursuit of short-run profit dictates that people be hired to works as hard as they can be made to work at wages as low as they will accept. There is not short run economic incentive for businesses to invest in improving the productive capacity of people if there are already people available who possess the skills and abilities needed. But, communities have a very large stake in maintaining the productive capacities of their members. In essence, a community *is* the collective whole of its people. If we allow the people of our community to be degraded, our community is degraded. If we allow our communities to be degraded, human society will be degraded.

No one has the wisdom to plot a true course toward a sustainable human society. At this point in time, we simply don't know how we can meet the needs of the current generation while leaving equal or better opportunities for those of future generations. But, we are beginning to learn some things that we cannot do. We cannot allow the economics of short-run, self-interest to determine the *use of our land and our people*. We know that the relentless pursuit of profits and growth will degrade both our natural and human resources, and will not leave as much and as good as we have today for those of future generations.

We also know that we cannot allow large, corporate organizations, such as CAFOs, do whatever they want to do wherever they have the money and/or votes to do it. Rural America may well be the place where America makes a historic stand for sustainability – just as the cities of the South gave birth to the Civil Rights movement. The first rural community to declare and defend the fundamental moral and ethical right of people to determine how land is used may be remembered much as Rosa Parks is remembered for refusing to move to the back of the bus in Montgomery.

The most significant long-run social, economic, and cultural impacts of CAFOs on rural

EXAMPLES OF PROPERTIES DEVALUED BY FACTORY FARMS

5

Examples of Properties Devalued by Factory Farms

Studies & Reports

In describing the economic costs of CAFOs to rural communities, the recent Union of Concerned Scientists report stated that "because property values are reduced near CAFOs, the residential tax base may suffer as well."
~ Doug Gurian-Sherman, Union of Concerned Scientists, *CAFOs Uncovered: The Untold Costs of Confined Animal Feeding Operations,* at 61 (April 2008).

The recent Pew Commission report on industrial farm animal production described the various negative impacts that factory farm facilities have on the environment, public health, animal welfare, and rural communities. The report did not directly address declining property values, but did note the negative influence factory farms have on rural social capital and the rights of neighbors to enjoy their own properties.
~ Pew Commission on Industrial Farm Animal Production, *Putting Meat on the Table: Industrial Farm Animal Production in America,* at 40-49 (April 2008).

This report was prepared to assist local boards of health who have concerns about CAFOs in their communities and to help them "understand their role in developing ways to mitigate potential problems associated with CAFOs." The report states that "[t]he most certain fact regarding CAFOs and property values are that the closer a property is to a CAFO, the more likely it will be that the value of the property will drop." It also noted that "[d]ecreases in property values can . . . cause property tax rates to drop, which can place stress on local government budgets."
~ Carrie Hribar, National Association of Local Boards of Health, *Understanding Concentrated Animal Feeding Operations and Their Impact on Communities,* at III, 11 (2010).

A technical report for the Pew Commission report discussed various CAFO studies and found that: "Industrialization of animal agriculture leads to the reduced enjoyment of property and the deterioration of the surrounding landscape, which are reflected in declining home values and lowering of property tax assessments. Recurrent strong odors, the degradation of water bodies, and increased populations of flies are among the problems caused by CAFOS that make it intolerable for neighbors and their guests to participate in normal outdoor recreational activities or normal social activities in and around their homes."
~ Pew Commission on Industrial Farm Animal Production, *Community and Social Impacts of Concentrated Animal Feeding Operations,* at 31.

In Iowa, one 1996 study found that proximity to a hog CAFO decreased neighboring property values in the following order: 40% within ½ mile; 30% within 1 mile; 20% within 1.5 miles, and; 10% within 2 miles.
~ William J. Weida, *The CAFO: Implications for Rural Economies in the U.S.* 1 (Colo. College & GRACE Factory Farm Project 2004) (citing Padgett & Johnson).

Another Iowa study found that there may be a 1-10% reduction in property values of residences upwind of new CAFO facilities, and that the drop in value "helps explain opposition by rural residents to large-scale feeding operations."

~ Joseph A. Herriges et al., *Living with Hogs in Iowa: The Impact of Livestock Facilities on Rural Residential Property Values* 19-20 (Iowa State Univ. Ctr. for Agric. Dev. Working Paper 03-WP 342 (Aug. 2003)).

A 1999 study in Missouri found that the average loss of land value within three miles of a CAFO was $112/acre.

~ Mubarak Hamed et al., *The Impacts of Animal Feeding Operations on Rural Land Values* 2 (Cmty. Policy Analysis Ctr., Univ. of Mo., May 1999) (finding that "there is a relationship between proximity to a CAFO and the value of property").

Studies cited by Dakota Rural Action found that property within a 3-mile radius of a CAFO loses 6.6% in property valuation, and property within 0.10 mile of a CAFO loses up to 88% in property valuation.

~ Dakota Rural Action, *CAFO Economic Impact* (June 2006) (citing North Central Regional Center for Rural Development (1999:46); Siepel et al. (1998)).

A Sierra Club study reported that county assessors in at least eight states lowered property taxes for neighbors of factory farms.

~ William J. Weida, *Nutrient Management Issues* (GRACE Factory Farm Project, Apr. 4, 2001) (citing Sierra Club, *Property Tax Reductions* (Mar. 13, 2000)).

A study in Berks County, Pennsylvania evaluated the impact of potential local disamenities on neighboring properties. It found that the impacts of CAFOs on neighboring property values did not vary significantly by species or by differences in the sizes of the operations.

~ Richard Ready & Charles Abdalla, *The Impact of Open Space and Potential Local Disamenities on Residential Rural Property Values in Berks County, Pennsylvania* i (Penn. State Univ., Staff Paper No. 363, June 2003).

This study evaluated the influence of proximity to swine facilities on the sale price of residential properties, using a GIS-based hedonic model. The study reported that "[r]esults indicate a negative and significant impact on property value from hog operations." The study also found that the modeling "may be a promising technique for establishing setback guidelines, for assessing property value damages resulting from animal operations, and for evaluating potential property value impacts to surrounding properties when siting a new CAFO."

~ Milla et al., *Evaluating the Effect of Proximity to Hog Farms on Residential Property Values: A GIS-Based Hedonic Price Model Approach*, 17 URISA Journal 27, 30–31 (2005).

A Putnam County, Missouri study found a $58/acre loss of value for properties within 1.5 miles of a CAFO facility.

~ William J. Weida, *The Evidence for Property Devaluation Due to the Proximity to CAFOs* 6 (Col. College & GRACE Factory Farm Project, Jan. 21, 2002).

Three different North Carolina studies, described in a presentation at the University of Kentucky, found that proximity and animal density have significant, negative impacts on the market values of residential properties.

~ Michael Thomas et al., *A Comparison of Three Recent Hedonic Models of Hog Farm Discommodity in Coastal North Carolina: Evidence of Diseconomies of Scale and Brown Zones* (May 2003) (citing studies of Bruton, Ansine etl al., and Kim).

A 2008 University of Northern Iowa study analyzed house sales in Black Hawk County, Iowa to determine the effect of hog CAFOs on property values. It found "large adverse impacts suffered by houses that are very close (within 3 miles) to and directly downwind from a CAFO."
~ H. Isakson & M. D. Ecker, *An Analysis of the Impact of Swine CAFOs on the Value of Nearby Houses* 19 (Univ. of N. Iowa Technical Report, July 23, 2008).

A 1996 newsletter from EPA's National Center for Environmental Economics reported on an early North Carolina State University study that used hedonic analysis to make various findings on factory farms and their negative impacts on residential land values.
~ USEPA, National Center for Environmental Economics, *Effects of Hog Operations on Residential Property Values*, 3:12 Newsletter (Dec. 1996).

A recent white paper by the Institute of Science, Technology and Public Policy reported on the negative impacts hog CAFOs have in Iowa, including "marked[] and consistent[]" decreases in land values and quality of life in areas near CAFOs. The report noted a study finding that "[p]roximity to a CAFO can reduce the value of a home by 40%."
~ Institute of Science, Technology and Public Policy, *Concentrated Animal Feeding Operations (CAFOs): Assessment of Impacts on Health, Local Economies, and the Environment with Suggested Alternatives* 3, 6 (post February 2007) (citing study of Park, Lee, and Seidl).

Articles

This 2001 article in the *Appraisal Journal* explains how CAFOs can negatively impact proximate property values, and lists several factors that should be considered in valuing those properties.
~ John A. Kilpatrick, *Concentrated Animal Feeding Operations and Proximate Property Values*, 39:3 Appraisal J. 301 (2001).

A 2007 article in the *Agriculture and Human Values* journal evaluated studies on industrialized farming and community impacts from the 1930s forward. It reported predominantly detrimental effects, including a decline in real estate values for residences close to hog CAFOs. ~ Lobao & Stofferahn, *The Community Effects of Industrialized Farming: Social Science Research and Challenges to Corporate Farming Laws*, Agric. & Human Values (2007).

In Waseca County, Minnesota, a county assessor designed a "smell location chart" to determine reductions in values of properties near feedlots. Factors in the percentage of reduction allowed included the proximity to the feedlot, the number of animals, and the presence of a manure lagoon.
~ Douglas Clement, *Knee Deep in Feedlot Feuds*, FedGazette, July 2001.

In January 2007, Indiana residents turned out to testify before the state legislature on a CAFO moratorium bill. One woman testified that a businessman was "'driven to suicidal thoughts because he was unable to sell his home after six years because of the odor from a nearby CAFO.'" Another testified that "'[d]ecreased property value because of CAFOs mean [sic] decreased revenue from property taxes, which means less money for our schools.'"
~ Jondi Schmitt, *Hoosiers Voice CAFO Concerns: Proposed Bill Would Put Three-Year Moratorium on Start of Construction*, South Bend Tribune, Jan. 30, 2007.

The Indiana House passed a bill in February 2007 that would prohibit new CAFOs within 1 mile of cities, towns, schools, and health facilities. One representative who supported the bill said he "want[ed] the pork industry to grow" in Indiana, but that growth could happen "while having respect to our neighbors." "CAFOs do decrease property values," he said.

~ Niki Kelly, *General Assembly: House Restricts Feed Farms,* The Journal Gazette, Feb. 22, 2007.

A Michigan Land Use article reported that a tax tribunal reduced the assessments for properties adjacent to CAFOs. It ordered local officials to reduce the taxable values of at least five rural homes by 35% based on problems with stench from a hog livestock factory, and on "slim sale chances" for the homes.

~ Patty Cantrell, *Michigan Tax Tribunal Recognizes Hog Factory Stench* (Mich. Land Use Inst., Dec. 7, 1999).

This 2004 paper debunked assumptions underlying CAFO-proponent arguments, including those regarding CAFOs and property use. It noted: "CAFOs generate odor, air and water pollution, all of which have a direct impact on neighboring properties. The closer the neighboring property, the more severe the impact is likely to be. . . . The resulting loss of exclusive use by neighboring properties lowers their values and ultimately also lowers the taxes generated from these properties. Suing the offending party for these nuisance activities could potentially compensate the neighboring property owners. To prevent this, factory farming interests have attempted to sponsor legislation to prohibit nuisance suits for agricultural pollution."

~ William J. Weida, *Considering the Rationales for Factory Farming* (for presentation) 10 (Mar. 5, 2004).

Clark County, Illinois established assessment abatements for fifty residential homes around a hog CAFO in the following order: 30% reduction within ½ mile; 25% reduction within ¾ mile; 20% reduction within 1 mile; 15% reduction within 1 ¼ miles; 10% reduction with 1 ½ miles.

~ William J. Weida, *The Evidence for Property Devaluation Due to the Proximity to CAFOs* 6 (Col. College & GRACE Factory Farm Project, Jan. 21, 2002).

A 2006 article in the *Journal of Ecological Anthropology* recognized the ill effects of factory farms on neighboring properties: "In addition to their negative effects on the local economy and tax base, large corporate operations are the source of environmental issues that threaten the property values of rural and urban residents. This strains the economic base and places higher burdens of taxation on remaining residents."

~ Barbara J. Dilly, *Tax Policy and Swine Production in Iowa,* United States, 10 J. Ecological Anthropology 45, 48 (2006).

A Peoria, Illinois newspaper reported that county officials lowered property values for at least 20 people with homes within two miles of a large sow farm and its odor. The tax board decreased assessments by 30% for neighbors with 1 ½ miles of the operation, and 10% for those within 2 miles of the facility.

~ *Board Smells Lower Land Values near Hog Farm,* The Journal Star, May 6, 1998, at A1.

An Iowa paper reported on the results of the University of Northern Iowa study mentioned above. One interviewee said that his neighbor had been offered $1 million for his land before plans for a hog lot were announced, but that after the announcement, "the would-be buyer walked away." "'He lost almost $1 million right there . . . . And it's not necessarily smell. It's psychological . . . . They don't want anything to do with them (hog lots) if they see them.'" Another interviewee, who had recently bought

land in the area, said she "'would not have bought the house and all the surrounding property . . . at above market value . . . if a CAFO was going to be built a mile away. . . . And to tell you the truth, I'll sell my property at a huge loss to move away if they build these things."
~ *UNI Study: Hog Lot Cuts up to 15% off Nearby Home Values*, Waterloo Courier, Mar. 12, 2007.

A 2006 Letter to the Editor in opposition to proposed legislation that would weaken Michigan's environmental laws described the "severe pollution" that CAFOs cause. The author explained that the growing number of CAFOs in Michigan was "threatening our public health, our rural communities and the viability of Michigan's 52,000 farms." She also noted that "[t]he stench from CAFOs has led to reductions in property values of up to 70 percent by the Michigan Tax Tribunal for nearby residents no longer able to enjoy or sell their homes."
~ Anne Woiwode Letter to the Editor, *Animal Sewage from Livestock Farms Threatens Communities*, Kalamazoo Gazette, May 15, 2006.

In February 1998, residents of Caribou, Maine petitioned the city council for a temporary ban on factory pig farms. Among concerns were "strong odor from waste, surface and ground water contamination and plummeting property values."
~ Gloria Flannery, *Caribou Councilors Seek Ban on Piggery; Fears of Pollution, Odor Lead to Ordinance Proposal*, Bangor Daily News, Feb. 25, 1998.

In an article summarizing newspaper coverage of concerns about large-scale swine facilities (LSSF) in Illinois, a "distinct undercurrent" of claims against the facilities was that they were "difficult for communities." Specifically, "[s]ources were concerned that LSSF were socially disruptive: they went against traditional community values, destroyed the community's history, violated ethics of neighborliness, and created community conflict. In addition, they were concerned that the community would have to develop infrastructure capacity to handle the effects of LSSF, paying for social services, schools, and health care for migrant workers and cleaning up spills and abandoned lagoons. Those opposed to LSSF also maintained that the large-scale operations had no overall economic benefit for communities because they displaced more jobs than they created, decreased property values and made alternative industries, such as tourism, less viable."
~ A.E. Reisner, *Newspaper Coverage of Controversies about Large-Scale Swine Facilities in Rural Communities in Illinois,* 83:11 J. Animal Sci. (Nov. 1, 2005).

Coverage of the 2007 Food and Family Farm Presidential Summit in Iowa noted that "many neighbors say the [CAFOs] stink up the air and foul the water, devastate their property values, and drive small farmers out of business."
~ Jennifer Jacobs, *Candidates Tout Their Farm Credentials*, Des Moines Register, Nov. 11, 2007.

Cases

In a 1997 Indiana Tax Court case, property owners asserted that a state board did not adequately consider the negative effects a proximate hog operation had on their neighborhood when assessing their property. To support their claim that odors from the operation impaired the enjoyment of their property, the plaintiffs presented two jars of air taken from their yard to the hearing officer. The Tax Court held that the plaintiffs met their burden of proving their assessment was incorrect based on the proximate hog operation's effect on the desirability of

their neighborhood. Relevant evidence that the plaintiffs presented included the two jars of air "redolent with swine" (though unopened, the hearing officer conceded they would smell bad), and verbal testimony about how the odor impaired the enjoyment of their property (they were unable to play tennis, open windows, or hang clothes out).
~ *Corey v. State Bd. of Tax Comm'rs*, 674 N.E.2d 1062, 1063, 1065-66 (Ind. Tax. Ct. 1997) (reversing state board's assessment on these grounds).

In a case before Indiana's Court of Appeals that was basically a zoning challenge to a proposed CAFO, some people who lived near the proposed CAFO presented evidence that their property values would decline if the CAFO were built. They presented testimony by their Township Assessor, who said:

> The first thing that has to happen if this hog operation goes in, is the neighborhood value will have to be lowered from a good to a fair or a poor . . . . [T]here's some houses like Flynns [sic], Bowmans and Jerry Marsh's, David Helt's there's some of them that the Sexton's house, there's two of them there that are pretty new houses, Steve Bowman's sister just built a new house up there. I wouldn't be surprised if they wouldn't drop 30 percent, I don't think it would be out of the question. So the property values will decrease in this area.

The Court held that the testimony was enough to show that the people near the proposed CAFO would "suffer a pecuniary loss" if the CAFO permit were granted.
~ *Sexton v. Jackson County Bd. of Zoning Appeals*, 884 N.E.2d 889, 893-94 (Ind. App. 2008).

In 2002, a Nebraska Court held that a tax commission should have considered the effect of a nearby factory farm on a taxpayer's property value. The taxpayer presented evidence from an appraiser who "considered that a potential buyer would take into account the odor produced by the hog farrowing facility," and adjusted the property's value downward for that and other reasons. The Court made several strong statements illustrating its conviction that factory farms impact neighboring property values:

> In the context of negotiations between a willing buyer and seller to arrive at fair market value, the neighboring hog facility and the house's location would unquestionably affect the market value of Livingston's house. Any other conclusion would mean that two identical houses, one located next to the railroad switching yard and the other next to the country club golf course, have identical values – an obviously arbitrary and illogical conclusion that no reasonable person would reach. . . .
>
> That many potential buyers would not look favorably upon the hog facility, and judge the home's value with reference thereto, is demonstrated by some well-known Nebraska cases in which homeowners have successfully sued hog facility owners for damages caused by interference with the use of their nearby homes. . . .
>
> No reasonable fact finder could conclude that in the real estate marketplace, a potential buyer would not notice, and react economically, to having a large hog facility very nearby while living in a remote location.

~*Livingston v. Jefferson County Bd. of Equalization*, 640 N.W.2d 426, 431, 437 (Neb. Ct. App. 2002).

In another Nebraska tax case, the state Supreme Court held that an assessor's valuation was "arbitrary and unreasonable" because it did not apply external/locational depreciation to a home that was near a cattle feedlot. The property owner provided testimony about problems with dust, trucks, and flies from the nearby feedlot. In addition, the well for the home was connected to the cattle-watering facility.
~ *Darnall Ranch, Inc. v. Banner County Bd. of Equalization,* 753 N.W.2d 819, 830-32 (Neb. 2008).

In a 1999 South Dakota case, the Court upheld the decision of a land commission to deny a permit for the siting of a hog confinement facility based on, among other things, devaluation of surrounding real estate.
~ *Coyote Flats, LLC v. Sanborn County Comm'n,* 596 N.W.2d 347, 352, 356 (S.D. 1999).

An appellate court in Illinois has recognized that factory farms can decrease neighboring property values. In *Nickels v. Burnett,* the Court upheld a preliminary injunction against building an 8,000-head hog CAFO based in part on "extensive evidence in the form of affidavits and scholarly articles authored by the expert affiants demonstrating that, if the hog facility were to begin operation, plaintiffs would experience substantially harmful health effects and a significant loss of value to their land." The Court found the "harms described were substantially certain to occur should the hog facility begin operations in its present proposed location."

The neighboring plaintiffs alleged that the facility would devalue their properties (among other things). The plaintiffs introduced the affidavit of a professional appraiser, who stated that neighboring property values would be reduced by 18-35%. They also presented affidavits from two doctors who concluded, respectively, that "years of downwind exposure to Hydrogen Sulfide even in low doses can cause permanent brain damage and . . . any exposure must be avoided;" and that "locating the proposed hog facility 3/4 of a mile or less away from homes is likely to cause medical and psychological symptoms to the people living in those homes." Another expert opined that "subjecting the Schmidt and Klein families (the families living closest to the site of the proposed hog operation), to the hog operation odors will significantly increase the likelihood that the two families will experience health problems and that it will cause significant detrimental effects on the quality of their lives." In his opinion, "subjecting the other 13 families, whose homes are located within 3/4 of a mile from the proposed hog operation, to the emissions generated by the proposed hog operation will increase their risk of health problems."
~ *Nickels v. Burnett,* 798 N.E.2d 817, 820, 826 (Ill. App. Ct. 2003); Brief of Appellees at 7-10.

In Pasco, Washington, an appraisal done for litigation purposes found an over 50% reduction in value of a family farm impacted by neighboring CAFO dust, flies, fecal matter, and odor. The CAFO settled the lawsuit by relocating the plaintiffs and buying their farm.
~ John A. Kilpatrick, *Concentrated Animal Feeding Operations and Proximate Property Values,* 39:3 Appraisal J. 301, 305 (2001).

In Michigan, a horse farm appealed its property tax assessment because it was located near a large scale pork processing facility. The horse farm got a 50% reduction based on airborne externalities and flies.
~ John A. Kilpatrick, *Concentrated Animal Feeding Operations and Proximate Property Values,* 39:3 Appraisal J. 301, 305 (2001).

In a 2002 Iowa nuisance case, the Court ordered a pork company to pay $100,000 to homeowners when their home dropped $50,000 in value after a nearby CAFO was built. The plaintiffs had alleged that the CAFO attracted bugs and harmed their physical and emotional health.
~ Associated Press, *Judge Awards Iowa Couple $100,000 in Hog Lot Lawsuit,* Amarillo Globe-News, Jan. 12, 2002.

In 1998 in Cedar County, Nebraska, property owners received an assessment reduction based on a neighboring CAFO. On the protest form to the tax board, the property owners stated: "Our neighbor has built a hog confinement and lagoon across the road from our house. This same neighbor has runoff from his cattle yards in to the road ditch 100ft from our well. The nitrates in our water ha[ve] increased making it not safe to drink. We feel a valuation increase of $35,340 is unfair." The board looked at the property and decided to assess a 25% locational depreciation.
~ Great Plains Environmental Law Center, Case Studies, Cedar County, Property Valuation Protest Form (1998).

In January 2002, in Calhoun County, Iowa, a jury awarded $76,400 in damages to four property owners who claimed a 4,000-hog operation within a mile of their properties diminished their property values. In another Iowa county, a Court had recently awarded $100,000 to other property owners for decreased property values from a nearby hog feeding operation.
~ Jerry Perkins, *Jury Sides against Hog-lot Firm: A Total of $76,400 Will Go to Residents Near the Facility,* Jan. 26, 2002.

A 1998 newsblurb from Kansas reported that a jury awarded $15,000 to retired farmers who live near a feedlot for diminished property values and loss of peace of mind.
~ *Across the USA: News from Every State,* USA Today, June 22, 1998.

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COMMUNITY-SPREAD MRSA
INFECTIONS RELATED TO PIG MANURE

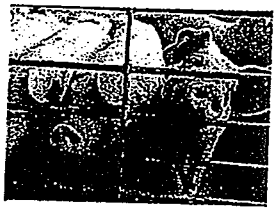
USA TODAY
September 16, 2013

6

Community-spread MRSA infections related to pig manure

Liz Szabo, USA TODAY 4:07 p.m. EDT September 16, 2013

Living near pig farms or where pig manure is used increases the risk of superbug infections, a new study says.



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Living near a hog farm or a field fertilized with pig manure significantly increases the risk of being infected with a dangerous superbug, new research finds.

Two new studies published Monday in *JAMA Internal Medicine* focus on a bacteria called methicillin-resistant *Staphylococcus aureus*, or MRSA, which caused more than 80,000 invasive infections in the USA in 2011.

These infections, which invade the body deeper than the skin, can be deadly for patients in hospitals or nursing homes who have weakened immune systems. The first new study, led by the Centers for Disease Control and Prevention, suggests that hospital efforts to reduce infections are paying off; the number of hospital-based invasive MRSA infections fell by more than half from 2005 to 2011.

In 2011, for the first time since officials began tracking invasive MRSA infections, more Americans were infected with MRSA in the community than in the hospital, one of the studies shows.

In the second study, researchers found that exposure to hog manure is related to 11% of MRSA infections, even among people who don't work on farms.

A--thors of that study, from the Johns Hopkins Bloomberg School of Public Health, compared infection rates of people who lived near one or more farms those who had no exposure to hog manure.

People with the greatest exposure to hog farms -- because they lived close to a large farm or several smaller ones -- were 25% more likely to develop a MRSA infection, compared to those with the lowest exposure, says lead author Joan Casey, a graduate student at Johns Hopkins.

But people didn't have to live near hogs to be at risk. Just living near any farm field fertilized with hog manure increased the risk of a MRSA infection, Casey says.

Those with the greatest exposure to fields treated with pig waste were about 38% more likely to develop a MRSA infection or a skin and muscle infection of any kind, according to the study, based on infections treated in eastern Pennsylvania.

Although hospitals have mounted major efforts to prevent MRSA infections among their patients, doctors have had fewer clues what causes MRSA outside of hospitals, Casey says.

People are known to be at higher risk of MRSA if they inject IV drugs or if they spend time in close contact with others, such as in the military, at schools or sports facilities or in prisons, she says.

Modern farming practices make their manure more of a problem than in the past. That's because pigs are commonly fed antibiotics to fatten them up, Casey says. About 80% of the antibiotics used in the USA, in fact, are used in food animals, according to the Food and Drug Administration.

While scientists don't completely understand why antibiotics make animals fat, Casey says it's possible that the drugs kill off natural bacteria in the animals' guts that would otherwise help prevent weight gain.

About 75% of antibiotics given to livestock end up in their manure, research shows.

...dition to those antibiotics, manure also contains bacteria that have evolved to resist those antibiotics, as well as free-floating antibiotic resistance genes, Casey says.

Casey says her study is consistent with earlier research, which has found that 45% of people who work on hog farms carry MRSA, mostly on the skin. That's 30 times higher than the general population. Carrying MRSA on the skin puts people at risk of an infection, which can develop when bacteria enter the body through a wound, she says.

"rmers can purchase antibiotics at the feed store that you or I would need a prescription for," Casey says. "We probably should be doing more to tect public health."

A pork industry group takes issues with the new findings.

Liz Wagstrom, chief veterinarian at the National Pork Producers Council, says the study doesn't prove that exposure to hog manure causes MRSA infections; only that a link exists. Wagstrom notes that none of the patients in the study was infected with the strain of MRSA most commonly found in pigs.

"We take our responsibility to protect public health very seriously," Wagstrom says. "In our work with CDC, they have not observed a single case of livestock-associated MRSA. . . Much of the slight increase in MRSA incidence could be explained by other factors, and is not well explained solely by proximity to livestock or crop fields."

In an accompanying editorial, Columbia University's Franklin Lowy writes that the new study "provides yet another reason to be concerned" about feeding antibiotics to livestock. Lowy, an infectious disease specialist, says the study also supports the need for legislation restricting the use of antibiotics in animal feed.

Last year, the Food and Drug Administration recommended phasing out the use of "medically important" antibiotics in animal feed, to help ensure that these drugs will remain effective in people. According to the FDA's voluntary guidelines, veterinarians should have to write prescriptions for antibiotics in livestock.

Environmentalists and others criticized the FDA guidelines as too weak, arguing that limits on antibiotic use on farms should be set into law.

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Karen Weintraub

Infectious disease dominated health news in 2013

FACTORY FARM IMPACTS
FACT SHEET

Socioeconomic and Public Health Impacts

7

Factory Farm Impacts
Fact Sheet

Socioeconomic Impacts

Factory farms decrease the quality of life in rural communities.

- Communities with factory farms have wider social and economic gaps than communities with small, locally-owned and operated farms. (Pew p. 42)
    - Factory farms affect the "size of the middle class, family income levels and poverty rates, quality of public schools, and strength of civil society organizations (such as churches and civic organizations)." (Pew p. 42)
    - Factory farms are related to greater income inequality between the affluent and the poor, and greater poverty in communities generally. (Stofferahn p. 18)
    - Residents in factory farm communities, where agribusiness influence is heavy, tend to have less control over local decisions. (Pew p. 42; Stofferahn p. 18)

- Factory farm odors impair the social life of communities. (Pew p. 42)
    - Nearby factory farms disrupt routines that "normally provide a sense of belonging and identity – backyard barbecues, church attendance, and visits with friends and family." (Pew p. 42)
    - The factory farms create feelings of "violation, isolation, and infringement" in place of freedom and independence. (Pew p. 42)
    - Factory farm communities suffer a decline in community organizations, civic participation, and social life. (Stofferahn p. 18)
    - Factory farm communities tend to have fewer (or poorer-quality) ublic services and fewer churches. (Stofferahn p. 18)
    - In a North Carolina study of residents within two miles of a 6,000-hog factory farm with an open lagoon, more than half of the respondents were not able to open their windows or go outside in nice weather because of the stench. (Wing & Wolf p. 236)

- Factory farms impair rural "social capital." (Pew p. 43)
    - Factory farms create rifts and conflict in communities, including threats from factory farms to neighbors. (Pew p. 43; Stofferahn p. 18)
    - Factory farm communities have higher levels of stress, socio-psychological problems, and teen pregnancies. (Pew p. 43; Stofferahn p. 18)
    - Neighbors of corporate-owned factory farms have more negative feelings about "trust, neighborliness, community division, networks of acquaintanceship, democratic values, and community involvement" than those living near independent farms. (Pew p. 43)
    - "Recurrent strong odors, the degradation of water bodies, and increased populations of flies are among the problems caused by CAFOS that make it intolerable for neighbors and their guests to participate in normal outdoor

recreational activities or normal social activities in and around their homes." (Pew Technical p. 31)

- A Duke University study in North Carolina found "significantly more tension, more depression, more anger, less vigor, more fatigue, and more confusion," as well as more "total mood disturbance" among residents who lived near large swine factory farm odors as compared to control subjects. (Schiffman et al.)

Factory farms decrease the value of surrounding properties.

- Various factory farm studies have found that: "Industrialization of animal agriculture leads to the reduced enjoyment of property and the deterioration of the surrounding landscape, which are reflected in declining home values and lowering of property tax assessments." (Pew p. 31)

- Factory farms devalue nearby properties to the extent the factory farms are seen as negative externalities by the marketplace. Factors like stigma, the type of affected property, the distance to the factory farm, physical impacts, engineering/scientific testing, impacts on property use, and marketability can reduce a property's market value by 50-90%. (Kilpatrick pp. 301-02)

- See "Examples of Properties Devalued by Property Farms" (under "Resources" on this website) for a long list of examples of properties devalued by factory farms.

Factory farms displace small farms.

- From 1982 to 1997, the number of small farms (less than 50 animal units) decreased between 23% and 28%. The number of factory farms with more than 1,000 animal units increased by 47%. (UCS p. 16)

- The number of CAFOs increased 234% from 1982 to 2002 (3,600 → almost 12,000). But the number of all farms raising animals decreased by 61% during the same time period. (GAO pp. 4, 63)

Factory farms hurt local economies.

- Factory farms have a lower "multiplier effect" than smaller farms. Rather than buying supplies and services from local businesses, they tend to buy from outside suppliers. (UCS p. 61)

- Factory farm communities tend to have less retail trade and fewer retail options. (Stofferahn p. 18)

- Factory farms are related to higher unemployment rates in the community. (Stofferahn p. 18)

- Because factory farms rely more on technology than labor, there are fewer decent jobs for local people. Instead, factory farm jobs tend to be low-paying and go to migrant workers who cannot find better jobs. (Pew p. 43)

- Factory farms reduce the local tax base but increase community expenses. For example, they take advantage of tax breaks but create higher road maintenance costs from their truck traffic. (UCS p. 61)

- Factory farms can reduce the residential tax base because they decrease the values of homes in the area. (UCS p. 61)

Factory farms create nation-wide economic burdens.

- Factory farms threaten free-market mechanisms because they control huge portions of the livestock industry. This happens where the four largest firms in an industry control more than 40 percent of the market. For broiler chickens, the four largest firms control 56% of the market; for beef, 83.5%; for hogs, 64%. (UCS pp. 19-20)

- Factory farms prosper through taxpayer subsidies. (UCS p. 29)
  - Farm bill subsidies for commodity grain crops have kept the price of animal feed low for factory farms. (UCS pp. 29-33)
  - CAFOs are major recipients of federal Environmental Quality Incentives Program (EQIP) funds, giving them a competitive advantage over smaller farms. (UCS pp. 37-40)

- Environmental contamination caused by CAFOs costs taxpayers billions of dollars to remediate. A "rough estimate" of the U.S. taxpayer cost to clean up soils under hog and dairy CAFOs is $4.1 billion. (UCS p. 4)

Factory farms disproportionately affect poor and African American communities.

- In North Carolina and Mississippi, CAFOs are often sited in poor or African American communities. In North Carolina, there were 7.2 times more hog CAFOs in the highest poverty areas as compared to the lowest, and 5 times more in non-white population areas as compared to white. (Hodne p. 28)

- Negative impacts are intensified by reliance on well water and barriers to medical care. (Hodne p. 28)

Factory farms treat animals inhumanely, compromising our ethical values.

- Factory farm animals are raised indoors in small spaces (e.g., veal crates, pig gestation crates, chicken battery cages) that allow only minimal movement and do not allow them to express natural behaviors. (Pew p. 33)

- Factory farm animals are fed unnatural or manipulated diets leading to pain and discomfort. For example, beef cattle in feedlots are usually fed grain instead of the grass for which their digestive systems were designed, often leading to internal abscesses. Laying hens may have their feed restricted to encourage molting and egg laying. (Pew p. 33)

- Factory farm animals are physically altered without pain relief (e.g., tail docking in hogs, beak clipping in chickens, and horn removal in dairy cows). (Pew p. 33)

Environmental & Public Health Impacts

Factory farms contaminate ground and surface waters, creating environmental and public health problems.

- Factory farms generate about 500 million tons of manure per year. (EPA p. 7180)

- Manure and wastewater from factory farms contain pollutants like nutrients (e.g., nitrogen and phosphorus), organic matter, solids, odorous compounds, salts, trace elements (e.g., arsenic, lead, and aluminum), antibiotics, pesticides, hormones, and more than 150 pathogens harmful to human health. (EPA pp. 7235-36)

- Factory farm pollutants reach ground and surface waterways through runoff and erosion; spills and lagoon overflows; direct discharges to surface waters; leaching into soil and groundwater; volatilization and redeposition to the land; and airborne travel through spray irrigation systems and attachment to wind-borne dust. (EPA pp. 7236-37)
    - In Iowa, there were 329 documented manure spills from factory farms from 1992-2002. A 1999 Iowa study also found that 85% of lagoons and ponds sampled on factory farms had seepage rates at or above Iowa's limit. (Hodne pp. 10-12)
    - A Centers for Disease Control study of nine Iowa factory farms found that pollutants likely moved from lagoons through surrounding soil, and over and away from lands where manure was applied. Samples found chemical pollutants and pathogens, metals, bacteria, nitrates, and parasites around the factory farms, with earthen lagoons having the highest levels of chemical pollutants and pathogens. (Campagnolo pp. 3-5)
    - When contaminated water is disturbed, bacteria and other microbes are re-suspended back into the water column for weeks. A North Carolina study on lagoon spills and surface waters found high levels of fecal coliform even 61 days after a spill. (Mallin)
    - A Centers for Disease Control study found that applying manure within 100 feet of a well doubles the likelihood of elevated nitrate levels. The study compared samples from wells that had had manure applied within 100 feet of the wellheads within the past 5 years to samples where no manure was applied. (Domestic Wells Survey)

- Water quality problems are exacerbated when factory farms are clustered together geographically. (GAO pp. 20-21)

- In the San Joaquin Valley in California, where limited water flows, pollution from clustered factory farms results in "long-term accumulation" of pollutants in water bodies. (GAO p. 22)
- Clusters of poultry operations on the Arkansas-Oklahoma border have impaired numerous surface waters in the region and also caused ground water concerns, according to EPA officials. (GAO p. 22)

- Excess nutrients, such as phosphorus and ammonia, lead to eutrophication in surface waters – causing fish kills, toxic algae blooms, red tides, hypoxia, shellfish poisoning, reduced biodiversity, and increased drinking water treatment costs. (EPA pp. 7235, 7238)
  - Nutrients from livestock and poultry operations in the Mississippi River Basin contribute to the largest hypoxic zone in US coastal waters (in the Gulf of Mexico). (EPA p. 7237)
  - CAFO manure also contributes to similar dead zones in the Chesapeake Bay and other important estuary regions along the East Coast. (UCS p.4)

- Organic matter decreases oxygen levels in water bodies as it decomposes, contributing to fish kills and the loss of other aquatic species. (EPA p. 7235)

- Solids like manure, bedding, spilled feed, hair, and feathers increase turbidity in surface waters, which decreases light penetration and hinders beneficial plant growth. They also transport other pollutants and settle on the bottom of water bodies, destroying important aquatic habitat. (EPA p. 7235)

- Manure contains the six pathogens responsible for more than 90% of food and waterborne diseases in humans, including Salmonella, Listeria, E. coli, and Giardia. They can be transmitted directly from manure to surface water and infect humans through things like swimming and shellfish consumption. (EPA pp. 7235-36, 7238)
  - In Walkerton, Ontario, 1,300 cases of gastrointestinal problems occurred and 6 people died from an outbreak of E.coli in May, 2000. The Ontario Ministry of Health and Long-Term Care determined that the likely cause was manure runoff near a drinking water well. (Canada Report)
  - In Milwaukee in 1993, the pathogen Cryptosporidium parvum passed through a water-treatment plant and sickened 403,000 people and killing 54. The pathogen was linked in part to cattle runoff (and also slaughterhouse and human sewage). (Hodne p. 24)
  - At a New York county fair, over 700 people got sick and 2 people died from an E. coli outbreak linked to manure runoff and a septic system. (Hodne p. 24)

- Since 2002, at least 4 peer-reviewed or government studies have directly linked hormones from factory farms with negative effects and malformations in the reproductive systems of aquatic life, laboratory rats, or human cells. (GAO p. 24)

- Nitrogen in manure transforms easily into nitrate form and can cause methemoglobinemia in babies, spontaneous abortions, and increased stomach and esophageal cancers when present in drinking water. It is not removed by conventional water treatment systems and is especially risky for those using domestic wells. (EPA p. 7238)

  - In Indiana in 1996, spontaneous abortions in humans were linked to high nitrate levels in wells near factory farms. (CDC pp. 569-71)
  - In 1998, factory farm wastes caused nitrate contamination in 34% of almost 1,600 tested wells near factory farms in North Carolina. 10% of the wells had nitrate levels at or exceeding the drinking water standard. (NC)
  - Increased nitrate in well-water is also linked to central nervous system defects in infants whose mothers drank the water. (Hodne p. 23)

Factory farms degrade air quality, creating environmental and public health problems.

- Livestock and manure at factory farms emit ammonia, hydrogen sulfide, particulates, odors, pathogens, methane, and nitrous oxides into the air, contributing to respiratory disease and global warming. (UCS pp. 55-56)
  - Decomposing animal urine and feces release at least 160 different gases, including hydrogen sulfide, ammonia, carbon dioxide, methane, and carbon monoxide. (Pew p. 16)
  - Since 2002, at least 7 peer-reviewed or government studies have directly linked air pollutants from factory farms (e.g., dust, hydrogen sulfide, odor, ammonia) with respiratory inflammation, asthma, allergies, headaches, eye irritation, and nausea. (GAO p. 25)
  - Livestock operations account for about 18% of human-induced greenhouse gas emissions (more than transportation). (LEAD p. 112)
    - Livestock-related emissions cause about 9% of human-induced global carbon dioxide emissions. Deforestation related to livestock-production causes about 2.4 billion tons of carbon dioxide emissions per year. The burning of fossil fuels to produce nitrogen fertilizer for livestock feed produces 41 million tons of carbon dioxide emissions per year. (LEAD pp. 88, 91, 112)
    - The livestock sector is responsible for 65% of human-induced nitrous oxide emissions and 64% of ammonia emissions (mostly from manure). (LEAD pp. xxi, 114).
    - Emissions from lagoons and anaerobic digesters create a global warming potential of 62 for methane and 275 for nitrous oxide over 20 years (compared with 1 for carbon dioxide). (Pew p. 27)

- Residents living near factory farms have higher levels of some diseases, such as respiratory and gastrointestinal illness, and impaired neurobehavioral health. (USC p. 60; Pew p. 17)
  - Children, the elderly, and those with chronic heart or lung disease are particularly vulnerable. (Pew p. 17)
  - Four large epidemiological studies demonstrated "strong and consistent associations" between factory farm air pollution and asthma. (Pew p. 17)
  - Volatile organic compounds emitted from factory farms cause increased neurobehavioral problems in people living near the factory farms. These include more negative mood states like tension, depression, fatigue, and confusion, and

neuropsychiatric abnormalities like impaired balance, hearing, and intellectual function. (Pew pp. 18-19)

- Hydrogen sulfide can cause "eye, nose, and throat irritation, diarrhea, hoarseness, sore throat, cough, chest tightness, nasal congestion, heart palpitations, shortness of breath, stress, mood alterations, sudden fatigue, headaches, nausea, sudden loss of consciousness, comas, seizures, and even death." (Yale § 2.3.1)
- An eastern North Carolina study of several communities reported significantly more headaches, runny noses, sore throats, excessive coughing, diarrhea, and burning eyes for residents near a 6,000-hog factory farm than for other residents. (Wing & Wolf p. 237)

- There is "direct evidence of harm to humans from occupational exposures within CAFOs." Harm includes asthma, sinusitis, chronic bronchitis, nose/throat irritation muscle aches, inflamed membranes, and progressive decline in lung function. (ISA/UI p. 6)
    - In studies, at least 25% of factory farm workers suffered from respiratory diseases like chronic bronchitis and occupational asthma. (UCS p. 60)
    - Factory farm workers also have increased levels of organic dust toxic syndrome. (Pew p. 16)
    - Factory farm workers and animals have died asphyxia and respiratory arrest from high hydrogen sulfide levels created by manure pit agitation. Those who survive hydrogen sulfide incidents often develop severe respiratory impairments or syndromes. (Pew p. 16; ISA/UI p. 6)
    - Hydrogen sulfide emissions are a leading cause of death in the workplace. (Yale § 2.3.1)

Factory farms contribute to antibiotic resistance.

- The overuse and misuse of antibiotics by factory farms creates antibiotic-resistant pathogens. Antibiotic-resistant pathogens cause diseases that are more difficult to treat and increase morbidity and mortality. (UCS p. 62-63)
    - More than 90% of *Staphylococcus aureus* bacteria isolates are resistant to penicillin, and the number of methicillin-resistant isolates rose from 2.4% to 29% between 1975 and 1991. Staph bacteria cause infections that can lead to septic shock and death. (Lieberman & Wootan)
- Antibiotic-resistant bacteria from factory farms reach humans through direct routes in food, water, air, and direct contact, or indirectly through increased resistance in the environmental pool of bacteria. (Pew p. 16)
    - In Illinois, tetracycline-resistant genes were found under swine CAFO lagoons and in groundwater up to 250 meters away. (Hodne p. 19)
    - A 2006 study found increased levels of airborne antibiotic-resistant bacteria inside and downwind of factory farms, with *Staphylococcus aureus* (MRSA) being the most common. (Gibbs et al. p. 1032)
- Up to 75% of antibiotics given to CAFO animals pass unchanged into animal waste to contaminate ground and surface waters. (Hodne p. 18)
    - In an Iowa study, all of the sampled swine waste lagoons had various antibiotics in them, and 31% of nearby water samples had antibiotics. (Hodne p. 19)

- In Ohio, 67% of water samples taken near poultry CAFOs had antibiotics in them. (Hodne p. 19)

Factory farms deplete energy and water resources.

- Producing crops for animal feed places "enormous demand on water resources," with 87% of freshwater use in the United States going to agriculture (mainly irrigation). (Pew p. 27)
- Factory farms use water to wash animals and flush manure and wastes from confinement areas. Many factory farmed animals also consume large amounts of water. A Missouri group estimated that an 80,000/year hog operation uses over 200,000 gallons of water/day – 73 million gallons/year. (NRDC)
- It takes 100,000 liters of water to produce 1 kilogram of grain-fed beef and 3,500 liters for a kilogram of chicken meat. In contrast, a kilogram of potatoes requires 500 liters of water; wheat, 900; rice, 1,912; and soybeans, 2,000. (Cornell)
- The ratio of fossil fuel inputs per unit of food energy produced for factory farms can reach 35:1. For other agricultural products combined, it averages 3:1. (Pew p. 29)
  - Beef cattle production requires 54 units of energy inputs for 1 unit of protein output. (Cornell)

Factory farms are unsustainable and threaten food security.

- Factory farms rely on intensive, industrialized grain production that degrades soil, pollutes aquatic ecosystems, and contributes to global warming. (UCS p. 25)
- More than half of the two most widely grown crops in the United States (corn and soybeans) is fed to livestock, not people. (UCS p. 29)
- More than half of U.S. grain and almost 40% of world grain is fed to livestock rather than directly to humans. If all the grain in the U.S. were consumed by people instead, it could feed 800 million people. (Cornell)

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~ Curtis W. Stofferahn, *Industrialized Farming and Its Relationship to Community Well-Being: An Update of a 2000 Report by Linda Lobao* (Sept. 2006) ("Stofferahn"), *available at* http://www.und.nodak.edu/org/ndrural/Lobao%20&%20Stofferahn.pdf.

~ United States Environmental Protection Agency, *NPDES CAFO Regulations*, 68 Fed. Reg. 7176-01 (Feb. 12, 2003) ("EPA"), *available at* http://www.fdsys.gov.

~ United States Government Accountability Office, *Concentrated Animal Feeding Operations: EPA Needs More Information and a Clearly Defined Strategy to Protect Air and Water Quality from Pollutants of Concern* (Sept. 2008) ("GAO"), *available at* http://www.gao.gov/new.items/d08944.pdf?source=ra.

~ Steve Wing & Susanne Wolf, "Intensive Livestock Operations, Health, and Quality of Life among Eastern North Carolina Residents," Vol. 108(3) *Environmental Health Perspectives* 233(March 2000) ("Wing & Wolf"), *available at* http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1637983/.

LETTER FROM WILLIAM A. KOLESZAR
INDIANA CERTIFIED RESIDENTIAL APPRAISER
TO BOARD OF ZONING APPEALS, BROWNSTOWN, INDIANA
DATED SEPTEMBER 10, 2012

8

September 10, 2012

TO: Board of Zoning Appeals, Brownstown, IN 47220

RE: CAFOs

As a real estate appraiser licensed by the State of Indiana and with over 30 years of residential appraisal experience, I was asked to provide my opinion as to the effect of CAFOs have on residential properties situated near these facilities.

Most local prospective purchasers perceive CAFOs to have offensive odors along with potential environmental hazards (even though these conditions may not actually exist). As a result, residential properties in reasonable proximity to CAFOs would likely suffer from reduced marketability and diminished property values.

Respectfully,

William A. Koleszar

William A. Koleszar
Indiana Certified Residential Appraiser
CR69100657

HYDROGEOLOGY. INC

REPORT ON KARST GEOLOGY AND WATER AVAILABILITY

9

hydrogeology inc.

1211 S Walnut St
Bloomington, IN 47401

Date:
May 14, 2014

Subject:
Hartsville, IN CAFO

Contact:
Jason Krothe

Phone:
812-219-0210

Email:
jnkrothe@hydrogeologyinc.com

Anderson Falls CAFO Fighters:

Hydrogeology Inc. respectfully submits this letter covering the following two topics regarding the confined animal feeding operation (CAFO) near Hartsville, IN.

1. Karst Geology
2. Groundwater Availability

Study Area
A CAFO operation is being proposed for a tract of land located southeast of the intersection of County Road 200 N and County Road 1100 E (Figure 1).

Karst Geology
Karst is a landform developed by the dissolution of soluble bedrock, typically limestone, over time. Dissolution occurs primarily along bedrock fractures, which subsequently control groundwater movement through the limestone bedrock. Over time, sinkholes and caves develop as the bedrock continues to dissolve. Sinkholes and caves located along ridge tops and drainages serve as the primary infiltration point for precipitation. Water infiltrates through these features, flows along karst conduits, and ultimately discharges at karst springs. Water in a karst groundwater systems receives little filtration as it moves from the surface to the subsurface, which makes karst aquifers particularly susceptible to groundwater contamination.

A review of the Indiana Department of Natural Resources (IDNR) water well records indicate that the two wells closest to the proposed CAFO site are completed in limestone bedrock (Figure 2). The United States Geologic Society Grammer Quadrangle depicts one sinkhole located approximately 3,000 ft southeast of the proposed CAFO (Figure 3). There is also a reference to a karst spring at the base of Anderson Falls in the report *The Mineral Waters of Indiana* by former state geologist W.S. Blatchley. While this information does not guarantee that the CAFO site is located in a karst area it does warrant further investigation. If the CAFO is located in a karst area it would make the potential for groundwater contamination more likely, with potential impacts to surrounding wells and springs. Prior to approval of the CAFO permit the site should be reviewed by a geologist with karst expertise to determine if the proposed CAFO is located in a karst area.

hydrogeology inc.

1211 S Walnut St
Bloomington, IN 47401

Groundwater Availability

The CAFO application indicates 4400 "wean to finish" swine will be housed in the building. Based on that number of swine the operation will require 61 gallons per minute (gpm) from a proposed well at the site. Two wells are located within 3,000 ft of the proposed CAFO site; IDNR well #216239 (2,680 ft northeast) and IDNR Well #216244 (2,860 ft northwest) Well #216239 (Figure 2). No pumping rate information is available for Well #216239. Well #216244 has a listed pumping test rate of 5.0 gpm for 0.5 hours with a drawdown of 45 ft which equates to a specific capacity of 0.11 gpm/ft. Based on the available head (51ft) listed in the well log the maximum yield for this well would be 5.7 gpm.

The required yield (61 gpm) of the CAFO well is much greater than the maximum yield (5.7 gpm) of the nearest well, Well #216244. If a rate of 61 gpm is achieved by the CAFO well, pumping at that rate could drawdown water levels in nearby wells. In the event that a well is installed at the CAFO site pumping tests should be conducted on that well with surrounding wells serving as observation wells. The purpose of such a test would be to determine the impact that pumping from the CAFO well would have on the surrounding wells.

In summary, I feel it is important for more investigation to be conducted to determine the impact the proposed CAFO could have on groundwater quality and quantity in the area.

Sincerely,

Hydrogeology Inc.

Jason Krothe
Owner/Senior Hydrogeologist

Figure 1: CAFO site.

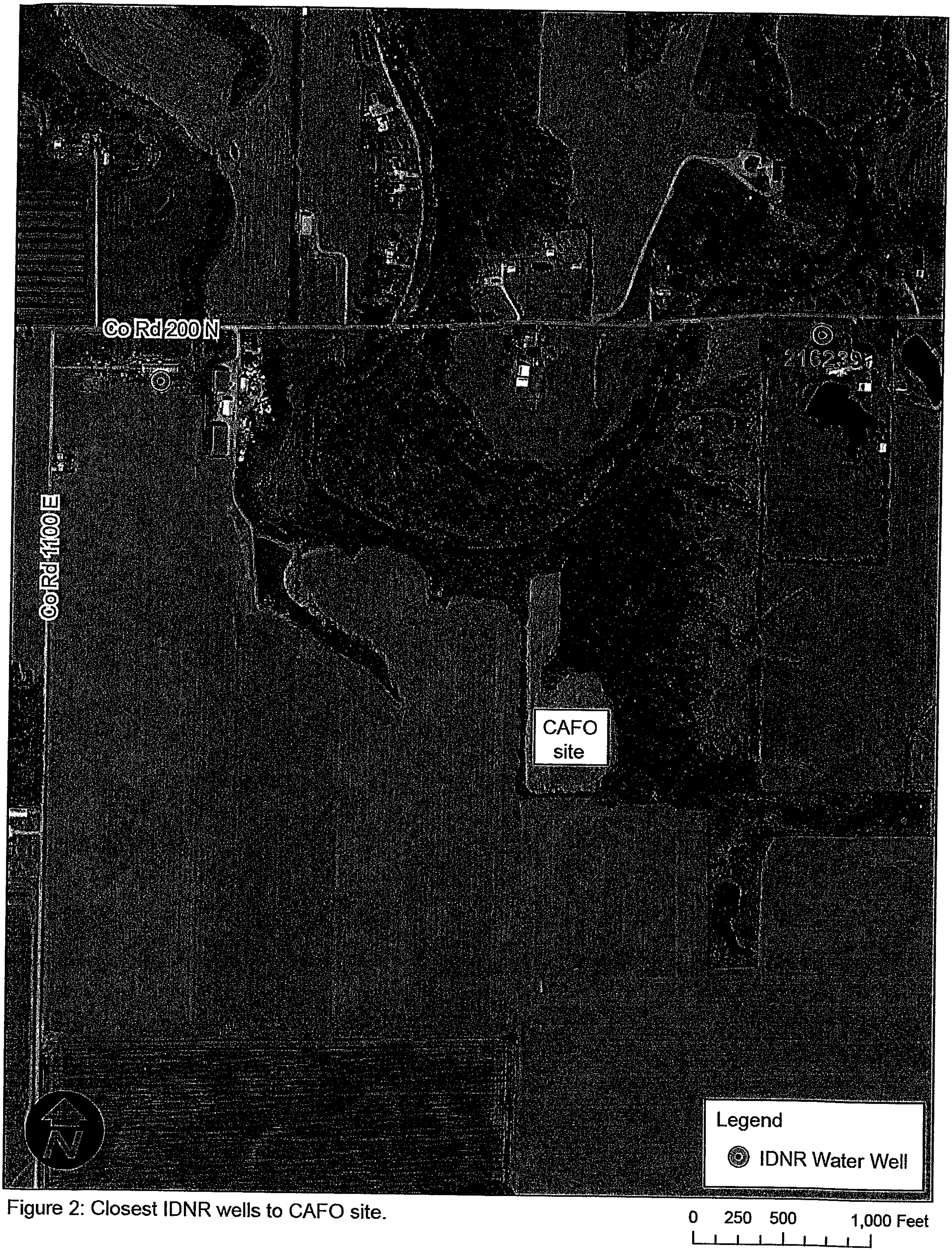


Figure 2: Closest IDNR wells to CAFO site.

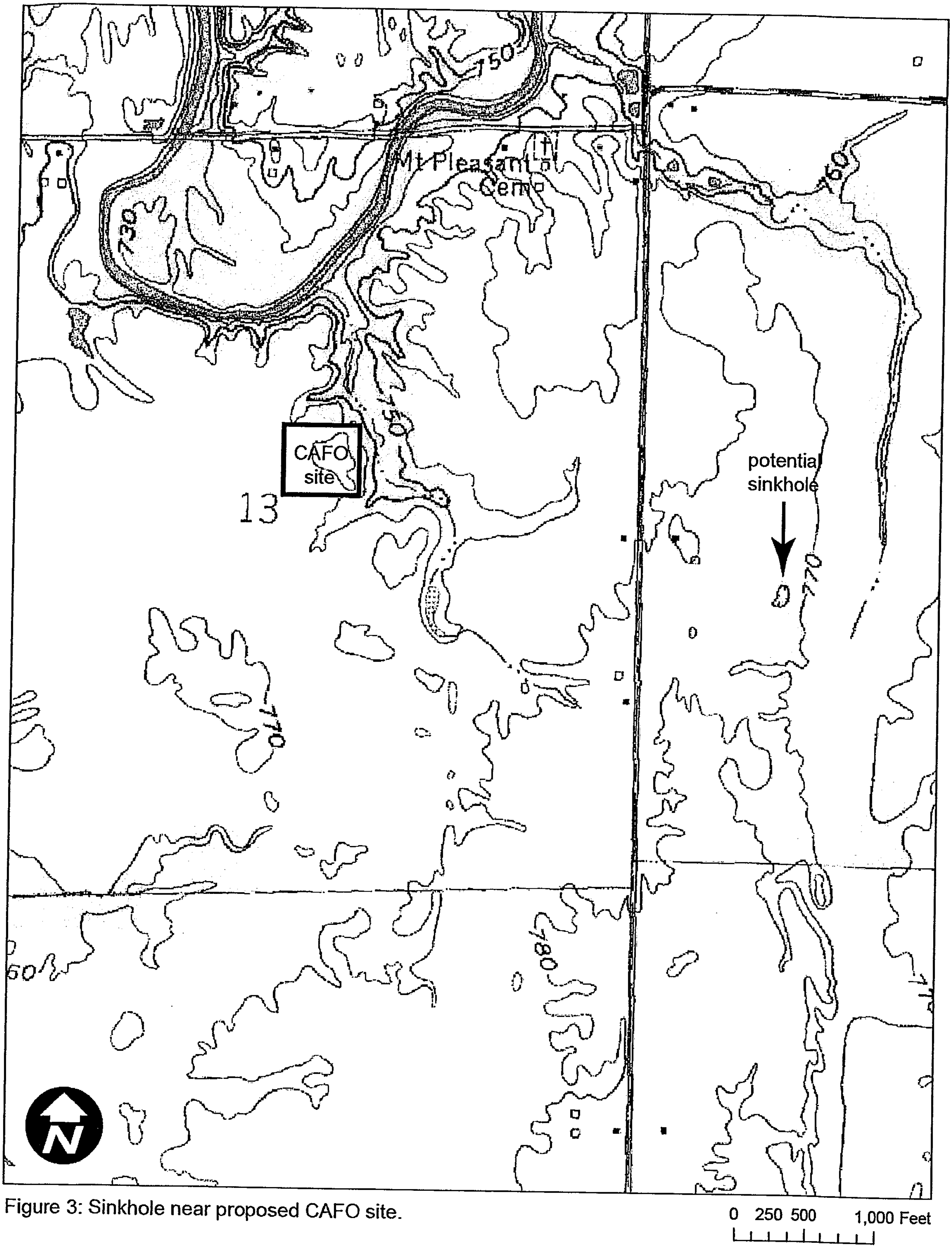


Figure 3: Sinkhole near proposed CAFO site.

INDIANA DNR

GROUND WATER AVAILABILITY SUMMARY AND CHART

10

Indiana Department of Natural Resources

Ground-Water Availability

Potential Yield Categories

There are seven ground-water yield categories in Indiana as shown on the Generalized Ground-Water Availability Map. Category 1 shows the poorest water yielding areas with well yields usually less than 10 gpm. Dry holes are common in many of these areas. Category 1a depicts areas of marginal ground-water supplies with well yields generally less than 10 gpm; however, yields of 50 gpm occur in localized areas. Some dry holes may also occur in these areas.

Category 2 represents areas of limited groundwater availability but slightly better than categories 1 and 1a. Wells are expected to produce between 5 to 100 gpm, although yields may be less in some areas. Category 3 includes areas with fairly good ground-water conditions, with yields from 100 to 200 gpm. Category 4 indicates those areas with wells capable of producing yields from 200 to 400 gpm. Category 4a identifies areas with very good ground-water conditions with well yields usually between 400 to 600 gpm. Category 5 delineates those areas where wells may potentially yield 1,000 or more gpm.

The various categories of ground-water yields are only a measure of the relative productivity of the several aquifer systems. These yield potentials do not indicate that an unlimited number of wells of the specified yield can be developed in any given location. Detailed studies, including exploratory drilling and test pumping, should be conducted to adequately evaluate the groundwater resource in any given area and the resultant change in water level as produced by the pumpage.

Regional Ground Water Conditions

Northern Indiana

In general, the ground-water resource of northern Indiana can be classified as being good to excellent. Exclusive of some areas in northwestern Indiana, well yields of from 200 to 2,000 gpm or 0.3 to 2.8 million-gallons-per-day (mgd) can be expected in most areas. Major areas of ground-water availability are found where the productive Silurian-Devonian bedrock aquifer system underlies large areas and where deposits of glacial material up to 500 feet in thickness contain highly productive inter-till sand and gravel aquifers. A number of major outwash plain and "valley train" sand and gravel deposits are associated with the St. Joseph, Elkhart, Pigeon, Fawn, Eel, and Tippecanoe River valleys. These sources are capable of large ground-water production. Wells with capacities greater than 400 gpm, or 0.6 mgd, are quite common.

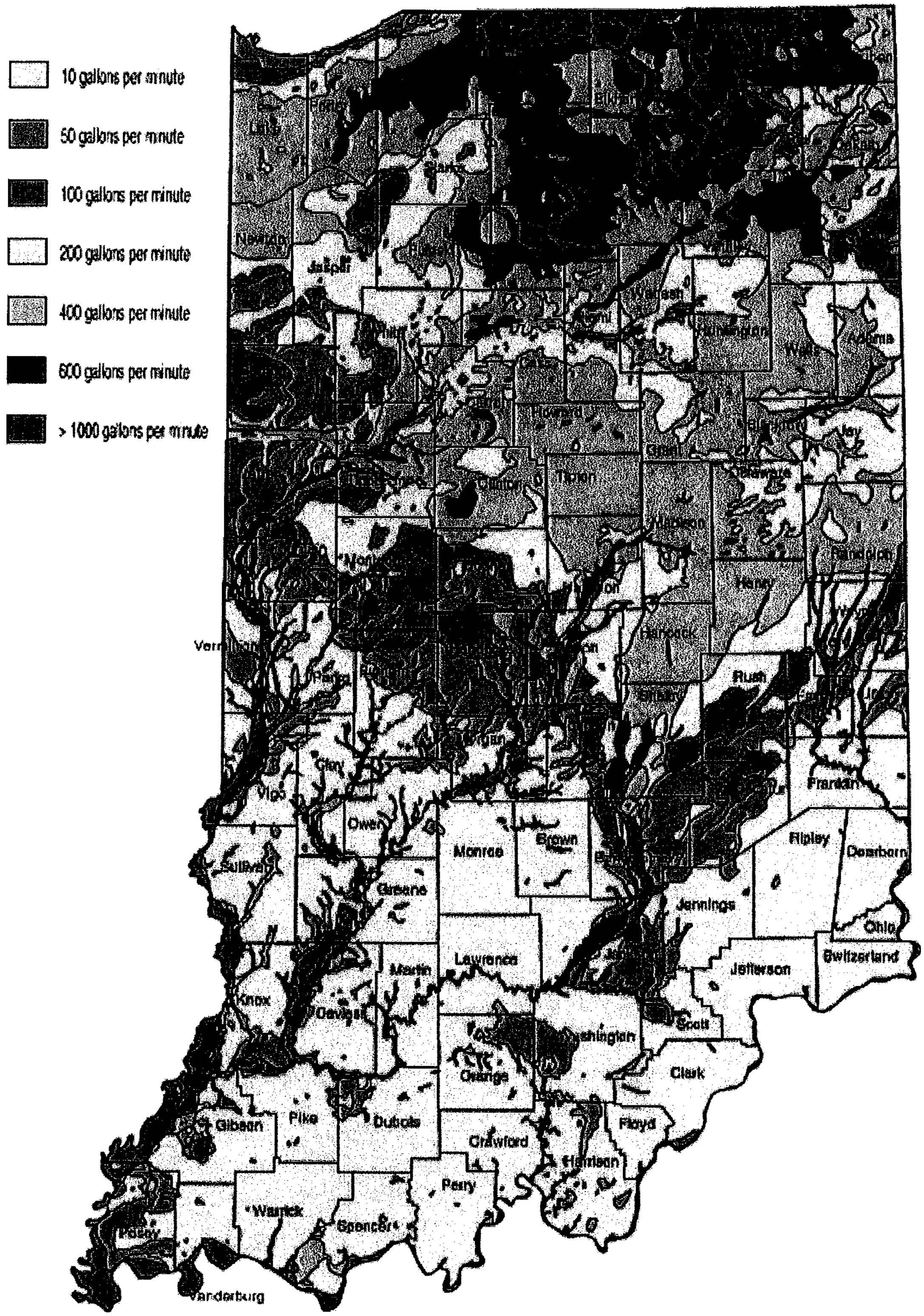
Central Indiana

In the central portion of the state ground-water conditions range from fair to good. Well yields from 100 to 600 gpm or from 0.15 to 0.9 mgd are typical for many large-diameter wells. Both outwash sand and gravel, limestone, and dolomite bedrock aquifers are tapped to meet the needs of the users of large volumes of water. Major ground-water sources are present in the valleys of the West Fork of the White, Whitewater, Eel, and Wabash Rivers, and in portions of the valleys of Eagle, Fall, and Brandywine Creeks and the Blue River. Bedrock aquifers in the Silurian-Devonian limestone sequence are also frequently utilized, and wells in these deposits are capable of yielding from 100 to 600 gpm or 0.15 to 0.9 mgd. Locally, thicker inter-till sand and gravel aquifers are present that are capable of meeting small municipal and industrial needs. These sources are normally capable of yielding up to 300 gpm.

Southern Indiana

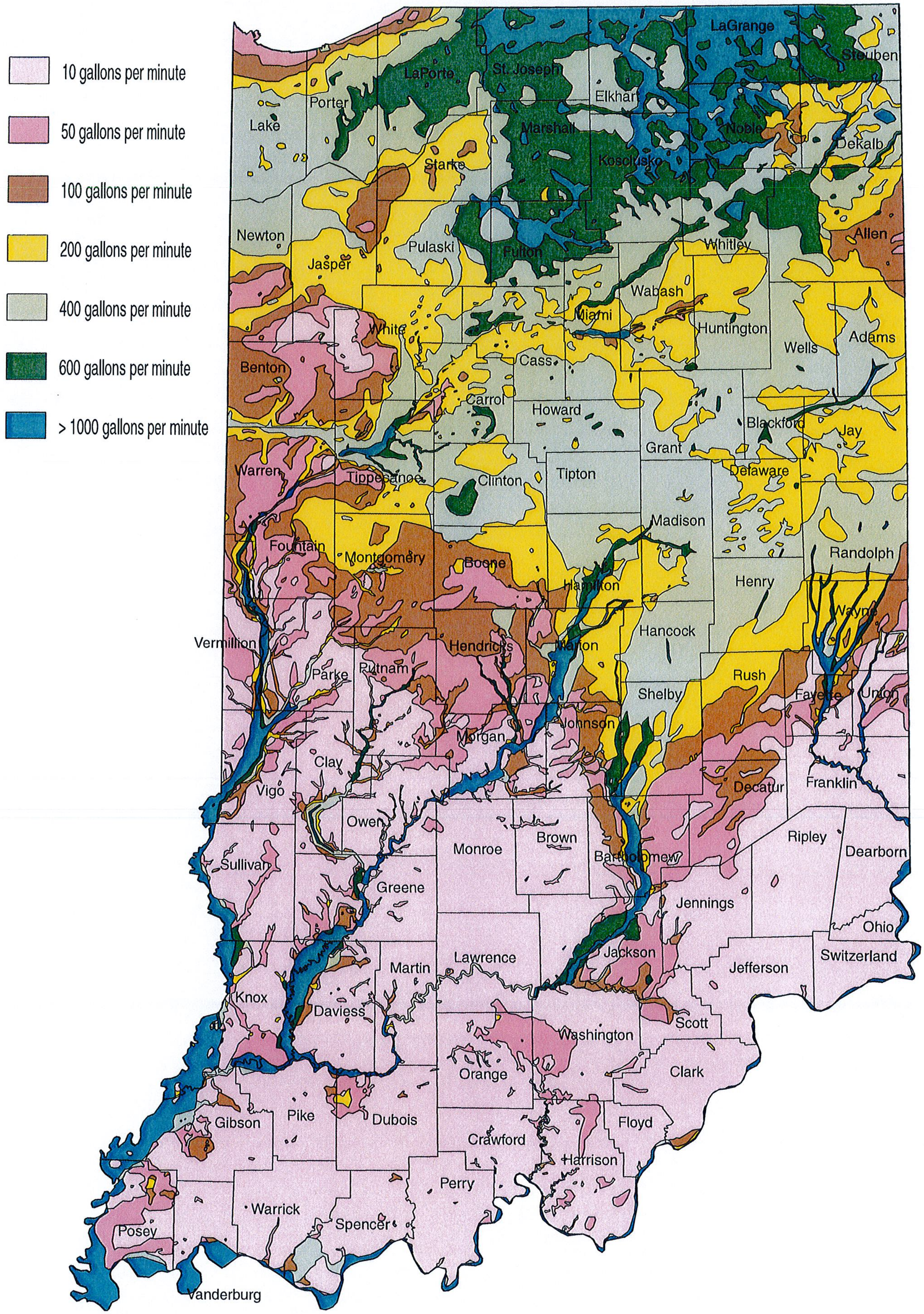
Many areas of the southern part of the state are particularly lacking in ground water, and only limited amounts, generally less than 10 gpm, are available to properly constructed wells. In these areas, the major sources of ground water are present in the sand and gravel deposits of the stream valley aquifers. These sand and gravel aquifers are extensively tapped by a number of municipalities, rural water systems, and irrigation users. The valleys of the Eel, Ohio, Wabash, and Whitewater Rivers as well as the East Fork, West Fork, and main stem of the White River are underlain by thick deposits of outwash sand and gravel capable of supplying over 1,000 gpm or 1.4 mgd to properly constructed, large diameter wells.

Generalized Ground-Water Availability



- View a pdf version of map (417kb file size)

Generalized Ground-Water Availability



U.S. EPA

INDOOR WATER USE IN THE U.S. SUMMARY

11

Indoor Water Use in the United States

Americans use large quantities of water inside their homes. A family of four can use 400 gallons of water every day, and, on average, approximately 70 percent of that water is used indoors.

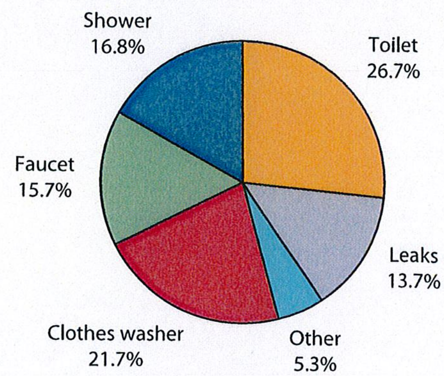
The bathroom is the largest consumer of indoor water. The toilet alone can use 27 percent of household water. Almost every activity or daily routine that happens in the home bathroom uses a large quantity of water. For example:

- Older toilets use between 3.5 and 7 gallons of water per flush. However, WaterSense® labeled toilets use at least 60 percent less water.
- A leaky toilet can waste about 200 gallons of water every day.
- A bathroom faucet generally runs at 2 gallons of water per minute. By turning off the tap while brushing your teeth or shaving, a person can save more than 200 gallons of water per month.

Outside the bathroom, there are many opportunities to save water. Here are some common water-efficiency measures, along with a few solutions to those problems you may not have known existed:

- High-efficiency washing machines can conserve large amounts of water. Traditional models can use 50 gallons or more of water per load, but newer, energy- and water-conserving models (front-loading or top-loading, non-agitator ones) use less than 27 gallons per load.

How Much Water Do We Use?



Source: American Water Works Association Research Foundation, "Residential End Uses of Water," 1999

- Washing the dishes with an open tap can use up to 20 gallons of water, but filling the sink or a bowl and closing the tap saves 10 of those gallons.
- Keeping a pitcher of water in the refrigerator saves time and water instead of running the tap until it gets cold.
- Not rinsing dishes prior to loading the dishwasher could save up to 10 gallons per load.

WaterSense, a partnership program sponsored by the U.S. Environmental Protection Agency, seeks to help families and businesses realize that they can reduce water use by doing just a few simple things, such as upgrading to higher quality, more efficient products. For more information, visit <www.epa.gov/watersense>.

INDIANA DEFINITION OF

SIGNIFICANT WATER WITHDRAWAL FACILITY

12

C

Effective: July 1, 2008

West's Annotated Indiana Code Currentness
Title 14. Natural and Cultural Resources (Refs & Annos)
Article 25. Water Rights and Resources
Chapter 7. Water Resource Management
→→ **14-25-7-15 Significant water withdrawal facilities**

Sec. 15. (a) As used in this section, "significant water withdrawal facility" means the water withdrawal facilities of a person that, in the aggregate from all sources and by all methods, has the capability of withdrawing more than one hundred thousand (100,000) gallons of ground water, surface water, or ground and surface water combined in one (1) day. Subject to subsection (b), the term does not include:

(1) water withdrawal facilities that function as part of the operation or construction of a landfill; or

(2) water withdrawal facilities located in or on an off-stream impoundment that is principally supplied by a significant water withdrawal facility.

(b) A water withdrawal facility referred to in subsection (a)(1) or (a)(2) located in the basin (as defined in section 1.2 of IC 14-25-15-1) is subject to the registration requirement of section 4.1.3 of IC 14-25-15-1.

(c) Every person who has a significant water withdrawal facility shall register the facility with the commission on forms provided by the commission that contain the following:

(1) The name and legal address of the registrant.

(2) The source of water supply.

(3) The total capability of the water withdrawal facility.

(4) The total withdrawal capability per day and the amount from each source.

(5) The use to be made of the water, the place of use, and the place of discharge.

(6) The geographic location of the supply source.

(7) The date of registration.

(8) Other information specified by rule.

(d) A significant water withdrawal facility must be registered within three (3) months after the facility is completed.

(e) The owner of a registered significant water withdrawal facility shall, within three (3) months after the end of each year, make a verified report to the commission on forms to be provided by the commission of the amounts of water withdrawn during the year.

(f) Under rules adopted by the commission, the department may waive the requirement of the information set forth in subsections (c) and (e) with respect to a temporary significant water withdrawal facility.

CREDIT(S)

As added by P.L.1-1995, SEC.18. Amended by P.L.123-1996, SEC.17, eff. March 21, 1996; P.L.4-2008, SEC.4.

HISTORICAL AND STATUTORY NOTES

Formerly:

IC 13-2-6.1-1.

IC 13-2-6.1-7.

P.L.164-1983, SEC.1.

P.L.20-1991, SEC.4.

CROSS REFERENCES

Registration of total withdrawal capability of Indiana portion of basin, see IC 14-25-15-12.

I.C. 14-25-7-15, IN ST 14-25-7-15

The statutes and constitution are current with all legislation of the Second Regular Session of the 118th General Assembly (2014) with effective dates through May 1, 2014.

END OF DOCUMENT

GELFIUS SITE

STORMWATER RUN OFF PHOTOS

13

communities could well be the beginning of a new revolution -- a revolution that ultimately will discard the outdated paradigm of short-run, self-interest economics for a new paradigm of sustainable economic, ecological, and social development.